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THE COMPENSATION OF LABOR.

By H. L. Gantt.

Mr. Gantt's paper following is probably the most comprehensive statement he has ever made of his view that all wage systems are "simply expedients to make employer and employee see the facts in the same light."—THE EDITORS.

IT has become an axiom in the commercial world that in the long run those transactions most promote prosperity which are advantageous alike to buyer and seller. It is coming to be realized in the industrial world that the same thing is true regarding the arrangements between employers and employees, and that no arrangement is permanent that is not regarded as being beneficial to both. In other words, the only healthy industrial condition is that in which the employer has the best men obtainable for his work, and the workman feels that his labor is being sold at the highest market price.

The employer who insists on more service than he pays for, and the employee who demands excessive wages for his work, both lose in the long run. The former worries continually about how to manage dissatisfied workmen who are continually on the verge of a strike, and in dull times the latter lives in constant dread that his employer may no longer be able to continue business and he may be out of work. The important thing for the average workman is not that he shall have exceptionally high wages during times of great prosperity, but that he shall have continuous employment and fair wages at all times; and it would seem to be the duty of the employer who makes large profits out of the services of his workmen during times of prosperity to see that these workmen shall have employment during times of depression. Granting this principle, which the most enlightened employers recognize as correct, the problem of the proper relations between employer and employee resolves itself into how to assure the workman practically continuous employment at fair wages.

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The answer to this is that it must be possible to meet all competition; in other words, manufacturing must be done at the lowest cost the available knowledge and appliances will admit of. The duty of an employer to his employees then demands that he shall maintain his plant and system of management at its highest efficiency, for only thus can he afford his men employment during times of sharp competition.

In other words, the expense of maintaining the efficiency of a plant up to the highest possible point is a legitimate charge on the earnings, and should be satisfied before any appropriations are made for dividends. In these days when scientific knowledge is increasing with such great rapidity and the means for utilizing it are being multiplied on every side, this charge is a large one, and alert manufacturers find that the percentage of the original investment that sufficed a few years ago to maintain their plant at its highest efficiency is today absolutely insufficient. This fact explains why plants whose names for years were synonyms for prosperity have gradually become less prosperous, and to day are scarcely holding their own by decreasing the wages of their employees. The next stage of such plants is to close indefinitely and to remain for years monuments to the short-sighted policy of their owners and the misfortunte of their employees.

The time to make provision against such a fate is not when sharp competition begins to show the need of it, but when prosperous times produce a large surplus of earnings. Out of such earnings ample provision should be made to take full advantage of all improvements in apparatus or management that are available.

When I speak of improving a plant, I do not necessarily mean enlarging it, but equipping it with the best and most efficient apparatus scientific investigation can suggest and ingenuity can devise.

When I speak of improving the system of management I mean the elimination of elements of chance or accident, and the accomplishment of all the ends desired in accordance with knowledge derived from a scientific investigation of everything down to the smallest detail of labor, for *all misdirected effort is simply loss, and must be borne either by the employer or employee.* In a proper system of management practically all loss of this character is eliminated, and the saving effected by this alone will usually pay all the expenses of the system and leave a handsome profit.

Wherever any attempt is made to do work economically, the compensation of the workmen is based more or less accurately on the efficiency of his labor. Very fair success in doing this has been accomplished in day work by keeping an exact record of the work done each day by every man and by fixing his compensation accordingly.

Piece work, in which the compensation is fixed per piece from past

records, or by the judgment of the foreman, is a crude attempt at the same thing; but, on account of a lack of knowledge as to what could be done, it has almost always had unsatisfactory results.

Mr. Halsey's premium plan, by which a workman is allowed a portion of the saving he can make over past records, has been useful in awarding the workman a share in the saving made by his effort; but as the workman seldom has the ability, and never has the opportunity nor the appliances, to make a complete investigation of any problem, this method always falls short of the best results.

In order to get the best results, which, in case of a machine is the maximum product from it, and in case of a labor operation is its most efficient performance, four things are necessary:

First:—Complete and exact knowledge of the best way of doing the work.

Second:—An instructor competent and willing to teach the workman how to make use of this information.

Third:—Wages for efficient work high enough to make a competent man feel that they are worth striving for.

Fourth:—A distinct loss in wages in case a certain degree of efficiency is not maintained.

These four conditions for efficient work were first enunciated by Mr. Fred W. Taylor, and when they are understood their truth seems almost axiomatic. They are worthy of a very careful consideration.

We never know whether the knowledge we have on any subject is complete and exact until it has been subjected to the criticism of a complete scientific investigation. Many people who have been accustomed to seeing an operation performed in a certain way imagine they know all about it and resent the intimation that there may be some better way of doing it. Anybody, however, who carefully analyzes the sources of his methods will find that the mass of them are either inherited, so to speak, from his predecessor, or copied from his contemporaries. He will find he knows but little of their real origin, and hence has no ground on which to base an opinion of their efficiency.

Even such a simple operation as shovelling is done very uneconomically in many places. The writer has seen the same shovel used for coal, ashes, and shavings, and this when coke forks were available for the shavings. The foreman had apparently given the subject no study and was content if the men were at work. The idea of working efficiently had never occurred to him. This is, of course, an extreme case, but it is a real one, and all degrees of efficiency exist between this and the case where each workman is provided with the proper implement and given a specific task, for the accomplishment of which he is awarded extra compensation.

The knowledge needed to set such a task in shovelling is much more complete than is at first realized, for hardly any two substances can be treated exactly alike, and the same substance is often much harder to shovel from the top of a pile than from the bottom which rests on a hard smooth surface. In studying this subject the first element to be determined is the size of shovel, which must be gauged to hold the weight which it is most economical to handle.

The second element is how long it takes to fill the shovel. For sand, fine coal, ashes, etc., it makes no difference in loading the shovel whether the material is taken from the top or the bottom of the pile, but in egg coal, broken stone, or lump ore the difference is very great; for, while it is quite easy to get a full shovel from the bottom of a pile which rests on a smooth hard surface, it is in some such cases practically impossible to fill a shovel from the top of a pile without actually raking the material onto the shovel. Again, the distance or height to which the material is thrown is a factor in all cases, because the higher or longer throw takes not only slightly more time, but because it takes more energy. We see that each such operation is composed of a number of elements, which may be studied separately. Having determined each element, they may be combined in a number of ways under a variety of conditions. Knowing the time needed for an operation we can add the percentage of that time needed for rest, etc., which has been determined, and calculate just how many shovelfuls a good man can average per minute without overexerting himself. We can readily get this done if we offer the proper wages for doing it. Again, if the problem is the economical operation of a machine tool, we must first consider what the essentials consist of:

1.—The machine must be run as continuously as possible.

2.—The work must be done as rapidly as the machine will do it.

In order to conform to the first condition, the machine must be kept in such good condition that it is practically exempt from breakdowns; the work to be operated upon and the appliances needed for doing it must be supplied before the previous job is completed.

To do work as rapidly as possible, it must be carefully studied and planned out beforehand, and the tools and appliances must be the best obtainable. Complete written instructions must be furnished the workman, and the expert who planned the work must be ready to come to his assistance if he is not able to follow promptly the instructions given. If the expert is a really competent man for the work and is supplied with proper knowledge concerning the machine and what is to be done, he can set a task such as he himself can do and give detail instructions for doing it. Having reached this point it is only a question of paying the proper price to get it done.

The necessary conditions, then, for obtaining the maximum result are knowledge, an interpreter of that knowledge, and proper wages; but while these will usually produce the desired result they will not always maintain it, but must be supplemented by the fourth condition, namely; *a distinct loss in wages on the part of the workman unless a certain degree of efficiency is maintained.*

The importance of maintaining a definite degree of efficiency is readily understood when we consider that a properly equipped plant has only its proper complement of each kind of machine, and if the output of any one falls below a certain amount, the output of the whole plant is diminished in proportion and the profits fall off in a much greater ratio. This fact does not appeal to the workman who has made good wages for several days and concludes to "take it easy" for a while, unless he also feels the loss his "easy going" causes his employer. Mr. Fred W. Taylor, who was first, and for twenty years the only person to put these ideas in operation, devised his differential piece-rate system to cover this point.

Elementary time study as applied to shovelling has already been considered, and the differential-rate system consists in fixing for any piece of work two rates, one about 20 per cent. higher than the other. If the work is done in the time in which the study indicates that a good man fitted for the work and working at his best normal speed can do it, or in less time, the rate paid is the high one. If the time taken is longer than this, the lower rate is paid.

To take a concrete example; let us suppose that a man can turn ten axles in a day on a certain lathe and the high rate is 30 cents each. If nine or less are done he gets only 25 cents each. His pay then for ten is $3.00 and for nine is $2.25. The difference between the pay for nine and that for ten is thus so great that a workman will make every effort to do the ten if he has a fair chance of success. If, however, the stint is set so high as to make its accomplishment the exception rather than the rule, few workmen will strive for it. I have applied the same idea in my Bonus System, which as most satisfactorily operated is identical with the differential-rate system, except that the workman who fails to get the bonus gets simply his day rate instead of a lower piece rate.

The method of operation is to determine the time to be allowed in exactly the same manner as in setting a differential rate, and if the work is done in the time set or less to allow pay for the time set, plus an additional amount of time, usually varying from 20 per cent. to 60 per cent. of that time. The percentage needed to make workmen strive for the bonus varies according to the severity of the work; and, while it averages 33 1/3 per cent., may amount to 100 per cent. when

the work is exceptionally disagreeable and severe. As stated before, the time set for doing any work must be that in which a good man can do it without over-exerting himself. This being the case, the exceptional man will make exceptional wages, for such a man will often be found who is 25 per cent. faster than a good quick man.

Among the difficulties of introducing this system is that of convincing employers of its possibilities, and hence their reluctance to award sufficient compensation to the employees to secure its successful operation. When, however, they realize that it actually does produce the maximum output of the plant, and that notwithstanding the increase of wages the cost is reduced to a minimum for that plant, they recognize the increased wages of the employees as their fair share of the increased profits. When this point has been reached harmonious co-operation between employer and employee becomes assured.

Disregarding the academic question as to whether wages in general are paid by capital or come out of the profits of the business, the fact that the increase of wages indicated is paid out of increased earnings makes the workman vitally interested in the subject of management, for a workman cannot hope to get even fair wages indefinitely, if the business is run uneconomically. *Every wasteful operation, every mistake, every useless move, has to be paid for by somebody, and in the long run the workman has to bear his share.*

Good management, in which the number of mistakes is reduced to a minimum, and useless or wasteful operations eliminated, is so different from poor management, in which no systematic attempt is made to do away with these troubles, that a man who has always worked under the latter finds it extremely difficult to form a conception of the former. The best type of management is that in which all the available knowledge is utilized to plan all work, and when the work is done strictly in accordance with the plans made. The worst type is that in which every man does his work as he thinks best. Between these two extremes are all degrees. The organization needed to carry out the former is complex; that needed to carry out the latter is simple. The output of a plant operated under the former is usually from two to five times as great as that of the same plant operated under the latter. Bearing this in mind, it can be readily understood how a plant that paid low wages and lost money under one system, might pay good wages and make a handsome profit under the other.

The subject of wages is then inextricably bound up with that of management. Poor management usually means poor wages. Good management means good wages, for the high efficiency demanded by good management can only be maintained by such wages as will attract good men and induce them to work at their highest efficiency.

GOLD MINING IN THE ANCIENT ROMAN WORKINGS IN SPAIN.

By Alex. Del Mar.

Mr. Del Mar is one of the leading authorities of the world upon the production and history of the precious metals and their use as money. He has been commissioner of mines, director of the United States Bureau of Statistics, a member of the most important monetary commissions, and author of epoch-making contributions on the subject of the precious metals. Of late years he has been engaged in examinations of gold, silver, and copper mines in various parts of the world for a London financial syndicate. His article following reflects the distinguished talents which have given him an international reputation.—THE EDITORS.

SPAIN was to the Romans what fifteen centuries previously Egypt had been to the Phœnicians, and what fifteen centuries later America became to the Spaniards—the Dorado, the Land of Gold, the Dream of Avarice. In Egypt one views almost with indifference the golden prisons of the Bisharee district, in which were immured those unfortunates whose requiem Diodorus has sung so pathetically—it was so long ago, the works are so primitive, and we know so little of the races who constructed or operated them. But such was not the case in Spain. There, the mining works were of the most stupendous character; while the pages of Livy, Pliny and Tacitus place before us not only the men who erected these works, but the manner of operating them, the measure of their product and, more than all, the tremendous social consequences to which the product gave rise. One has only to recall the Halcyon Age which followed the flow of the precious metals from America to Europe during the 16th and 17th centuries, say from 1550 to 1650, to realise the Augustan Age of Rome, when all the world, Egypt, Asia Minor, Greece, Noricum, Rhætia, Gaul, Britain and Spain, especially Spain, poured into her ample treasuries the golden tribute of her numberless criminals and slaves.

Many of these ancient mines and mining works have within recent years been made the subjects of commercial negotiation and have thus afforded to the engineering fraternity opportunities to investigate their history and the ancient mode of working them. It is this view of the Roman engineering works in Spain that it is desired to submit to the reader.

It happens that the most remarkable of these works—the gravel banks and hyyraulic works of Las Medulas—selected no doubt because they *were* the most remarkable—are alluded to in Pliny's account of gold mining in Spain. These works were situated about 28 miles from Monte Teleno, on the border line of the provinces Leon and Orense, near Lat. 42.28 North, Long. 6.50 East, embracing the mines, water-works, ground-pits, galleries, canals, sluices and booming apparatus presently to be described.

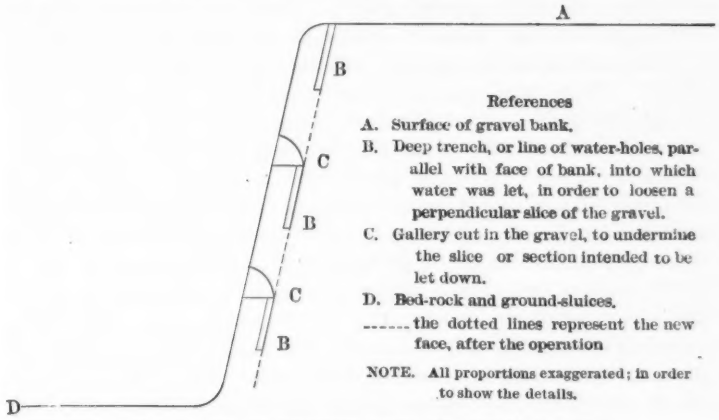
Originally the gravel banks rose from 50 to the almost incredible height of 750 feet above bed-rock, and covered an area of probably 1,500 acres, of which 1,000 acres, averaging 150 feet in height, were worked off by the ancients, leaving say 500 acres, rising from 500 to 750 feet above bed-rock as yet untouched and—it may be added—practically untouchable. The sketch opposite represents the present appearance of the gravel banks and indicates the method pursued by the Romans to break them down and run the gravel into the ground-sluices.

Pliny's account of the operation is much too long to be quoted entire. After describing the method of mining for quartz, and remarking that "the greed for gold" is even more insensate than the gold-enclosing rocks themselves, he turns abruptly to gravel-mining and says:—

> "When these operations are all completed, beginning at the last" (he hasn't said a word yet about gravel-mining; so that the text must be very imperfect or corrupt) "they cut away the timbers which support the roof, (of the gallery which has been cut along the face of the cliff,) the coming downfall gives warning when the time comes, and this is perceived by the sentinel who is set to watch for it upon a suitable elevation hard by. With voice and gesture he directs the workmen (below) to stand from under, and at the same moment takes care of his own safety. The mountain, rent by art, is cleft asunder, hurling its débris to a distance and with a tremendous tumult, which it is impossible for the imagination to conceive; and from the midst of a cloud of dense dust the victorious miners gaze upon this downfall of nature."

After describing how water is brought from a distance of many miles to the brow of these cliffs—of which more as we proceed—and how the fallen gravel is run through ground and wooden sluices, fitted with riffles of ulex to catch the gold, Pliny follows the gravel to the sea, the shores of which, he avers, are greatly extended by its deposition. Although he says nothing about the use of mercury for the purposes of amalgamation in mining for gold, there are reasons for believing that the ancients were well acquainted with this art:—1, the quicksilver mines of Almaden were worked by the Romans and upon a scale which it would be difficult to account for

upon any other grounds; 2, the attraction between quicksilver and gold is mentioned by Pliny in another part of his work; 3, the name of the god Mercury, is believed to have been given to this metal in order to render sluice-robbery sacrilegious.


A
B
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D
References
A. Surface of gravel bank.
B. Deep trench, or line of water-holes, parallel with face of bank, into which water was let, in order to loosen a perpendicular slice of the gravel.
C. Gallery cut in the gravel, to undermine the slice or section intended to be let down.
D. Bed-rock and ground-sluices.
------ the dotted lines represent the new face, after the operation
NOTE. All proportions exaggerated; in order to show the details.

ROMAN METHOD OF BREAKING DOWN GOLD-BEARING GRAVEL.

Pliny continues as follows:—

"An equal labor (to mining) is that of bringing streams from mountain heights, for a distance sometimes of a hundred miles, to wash the gravel. The ditches formed for this purpose are called *corrugi*, and even when these are quite made, they entail fresh labors. The grade must be such that the water will run rapidly. Then, in places, it must be carried in flumes over gulches and valleys, or along the face of impenetrable rocks, which have to be excavated to receive the sluice-boxes; the workmen hanging suspended by ropes, like so many birds upon the wing. In this position they take the levels and trace with lines the course of the water. . . . . When they have reached the brow of the cliffs (with the water), reservoirs are hollowed out a couple of hundred feet in length and breadth, and some ten feet in depth. These reservoirs are usually provided with five sluices, each about three-feet square; so that when the reservoir is filled, the sluice-gates may be struck away, when the mass of water descends with such violence as to sweep the very rocks before it."

To one who has visited these works it is abundantly evident that Pliny never saw them and that his description, notwithstanding its prolixity, is drawn from some other authority. As Pliny was Procurator in Spain about A. D. 66 and as such was entrusted with the management and collection of the revenue, a material portion of which was derived from the mines, it would seem strange that he omitted to witness personally the working of this very im-

portant one, unless at the period of his incumbency it was already exhausted and no longer in operation. Such was therefore probably the case. A peasant in the neighborhood of Las Medulas sold me a genuine aureus of the Emperor Nero, which he said had been found in one of the ground-sluices. As it was struck during the earlier years of that emperor's reign, A. D., 54-68, it may fairly be assumed that the works of Las Medulas were closed down about A. D. 60. From that time to the present—unless the Arabs of the Middle Ages essayed to attack its lofty flanks—the mine has remained unmolested, save by the birds in the day and the bats by night.

Close to the left bank of the river Sil winds the highway to Domingo Flores and Corunna, and on this highway stands the wretched hamlet of Carrucedo, from which to Las Medulas is under three miles. The ascent is from altitude 1,500 to 2,225, a rise of about one foot in twenty. The road winds through the "dump" of the mines, which is interspersed with immense stacks of boulders and cobble-stones, arranged with great precision, and covered with the gray moss of ages. Between these stacks, the dump is now laid out in cultivated fields, where, under the shade of hoary old chestnut trees, a dwarfed and impoverished growth of wheat struggles toward the sun. The road is steep, but it is bordered with wild roses and lavender; and one forgets the fatigue of the journey as he inhales their sweet perfume. Half-way up we stopped and gazed over the spacious fields which once formed the main sewer of Las Medulas and where myriads of Roman captives must have breathed their last, in the unremitting and savage drudgery of the mines. Here were assembled a vast host of unfortunates from all parts of the world, prisoners from Carthage and Judea, from Britain and from Egypt, flaxen-haired whites from the Baltic, wooly-haired negroes from Africa, freedmen from Rome (those who had been "ungrateful" to their patrons) and even legionary soldiers. This was the Siberia of the ancient empire, the golden prison beyond the sea, the "undiscovered country from whose bourne no traveler returned." Here all their laments were united; here all their hopes were dissolved; here all their sufferings were entombed. The stacks of boulders which they themselves erected are their monuments; the gray moss is their epitaph. So long as time shall endure, will these probably remain; for so vast is their bulk that it would require another army of slaves to remove them.

About an hour after leaving Carrucedo we reached Las Medulas. This pueblo consists of say forty or fifty houses, scattered about the upper portion of the ancient sluice-ways, which had many rami-

fications. The air of the place, when one does not venture too near a house or one of the inhabitants, is pure and refreshing. The women are the handsomest in Northern Spain, with countenances of a Roman cast. Instead of the *madrenyos*, or wooden shoes of the country, they wore leather ones, as in more civilised regions. The men were almost as handsome as the women. Ramiro, the son of our hostess, a youth of 20 years, was as neat a looking fellow as one might find in the Abruzzi. Roman, too, decidedly Roman. It was no longer a fancy—we were sure of it now. Some of the old legionary soldiers must have remained here, with their families, after the mines were abandoned by the Government; just as the Hessian soldiers settled in Pennsylvania, upon the close of the Revolutionary war. After a walk through the village, which proved to be as dirty as the other villages in this part of the country, we put up at the only house where the traveler can find entertainment at Las Medulas—that of the widow Carlota Ascasvero Lopez. In this house the hearth was composed of a raised platform of slate slabs, framed or bordered by logs. The domestic fire was built in the centre of this platform, and over it was suspended an iron pot. Long wooden benches were arranged on each of the two sides of the hearth, and here the family sat, while the pot boiled. The smoke, as in the other houses of this country, found its way out the best way it could. There was no chimney. In my bedroom there was a cot, a chair, a table, and a chest; all of heavy wood, hewn with adzes. In the chest were kept the bed-linen and towels. The washstand was a wooden bench on the porch. The fare at supper was coarse, but we fancied it was much cleaner than elsewhere throughout Leon. To bed at 9 o'clock and up at 4 in the morning, when, with Ramiro for a guide, we started to surmount Las Medulas.

It took an hour to reach the top, but the view well repaid the toil of the ascent. Towering up from the faintly descried village, their summits being the plateau upon which we stood, were the monstrous gravel buttresses of Las Medulas. Far below, on the right, wound the river Sil; on the left, the Cabrera; and at their junction, the town of Domingo Flores, bearing southwest by west. The intermediate country consisted of lofty hills and broken ridges, destitute of trees. Near the edge of the gravel cliffs wound the road from Orellan to Buenos Yrenes; and as we followed this around and crossed a saddle that led from the summit of the gravel cliffs to the mountain behind them, we came in sight of the Roman ditches which led the water to the ancient mines. Six of them are plainly discernible; some observers have made out a seventh. They

are arranged one above the other, like so many parallel zones, carved upon the rocks. The lowest one was no doubt constructed first and the other ones subsequently, as a greater and greater altitude of water was needed to wash the mines.

These ditches are cut in slate, the stratification of which is almost perpendicular, as we have seen it in many parts of Nevada County, California. That it was not difficult to cut, is proved by the fact that the cart-wheels on the Orellan road have cut deep ruts in the same rocks, by merely passing over them. We jumped down into one of the ditches and examined it closely. It measures exactly five feet in width on the bottom. The width at the top is not so clearly defined, the elements having worn away the rock and broken down the outer bank; but we fancy it must have been over seven feet wide, with a rise of about three feet, exclusive of the bank formed by heaping up the excavated contents. The grade appears to be about twelve feet to the mile, although this could not be determined with precision, without tracing the ditch for a much longer distance than was deemed expedient. This is so different from Pliny's "rapid" grade that it almost seems that the text confuses the details of two different localities. The grade appears to be uniform; and to make it so, the Romans must have used a good leveling instrument; an inference that suggests the use of mercury for the purpose. In fact, the work appears to be thoroughly well done. Without the aid of gunpowder it seems wonderful that it should have been accomplished at all.

These ditches are 26 miles long; and as there are seven of them, the amount of rock-cutting was no less than 182 miles. The water was brought from the upper portion of the river Cabrera. Of course, the ditches have no water in them at present, nor have they had, for many ages; the ditches having been broken down long since. But enough of them remains to evince the skill, and the indomitable energy, of those who constructed them. Every inch of these 182 miles was chiseled out by hand, except where the ditches intersected depressions which had to be bridged by flumes. Myriads of lives must have been sacrificed in this work. It almost rivals in grandeur the famed pyramids of Egypt.

Half an hour after leaving the summit of Las Medulas we paid our bill and adieus at the village and were on our way back to Carrucedo. Below this hamlet—between it and the river Sil—more wonders remained to be explored. To appreciate these, it must be premised that the immense mass of debris that flowed down from Las Medulas was arranged to fall into the river Sil, but that on its

way thither it accumulated in vast heaps, which the water from the base of the cliffs was inadequate to carry off. In order to wash it away and carry it into the Sil, resort was had to the device known in California as "booming."

Near Carrucedo and at an altitude of more than 1,000 feet below the bed-rock at Las Medulas, there anciently ran a stream which emptied by an acute angle into the Sil. This stream, which may be called the Rio Carrucedo, was dammed up by the Romans at a point above Carrucedo and its waters allowed to accumulate so as to form a lake, which still exists and is of such dimensions that it is several miles across. Below the dam they sank the river-bed 50 to 75 feet beneath its natural level; so that when the lake was let down, its flood might not damage the adjacent country. Into this sunken river-bed, and at right angles to it, flowed the debris of the mines Thence all the lighter portions were swept into the Sil, but the heavier portions remained and clogged up the sunken river-bed. To remove this deposit, the flood gates of the dammed-up lake were periodically removed, and the whole of its vast contents let down at once. The effect was not only to sweep away the deposit of boulders and cobble stones in the sunken river-bed, and to carry them into the Sil, but afterwards to urge them, together with the deposits of pebbles and sand in the Sil, down, down that swift river, until the entire mass was hurled through the Minho into the ocean.

The marks of these "booms" can be seen today along the rocky walls of the Sil. The operation must have been most terrifying. Imagine an impetuous rush of waters, 100 feet or more in height, charged with stones greater than cannon-balls, flying through a rocky defile, which, in many places, is not more than a few hundred feet in width! If the precision of the Roman rock-ditches commands our admiration, the magnitude of this booming apparatus must elicit something akin to reverence for its authors. One can scarcely regard one of our battleships, or the Brooklyn bridge, the Chicago water-works, or the hydraulic jets of California, without being impressed with profound admiration for the genius which planned and executed such gigantic works of art. When it is said that they all dwindle into insignificance beside the colossal works of Las Medulas, it will perhaps be understood what sort of miners the Romans were.

The same men who planned these works, turned the river Sil at a point lower down in order to "clean-up" its bed for gold. This was done by cutting, through a promontory of solid rock, a channel wide enough for the egress of the waters, and high enough for a

sail-boat with main-sail up to pass through it. They built macadamized roads from these mines and others in the vicinity, to the eastern ports of Spain. They altered the entire face of the country, levelled its mountains, filled up its valleys, subdued it, tamed it, robbed it, ruined it, and then flung it to time and the elements.

Yet one takes his leave of their achievements with the same regret with which he turns his last look upon the Roman Forum, the Coliseum, and the arches of Titus and Severus. The men who erected these structures recked at nothing and knew no mercy; but both in the design and execution of their works, they were giants.

The guarded manner in which Pliny states the output of gold from Spain furnishes ground for the belief that, like America under Spanish rule, the Spanish mines yielded more gold than the Roman treasury received, or than was reported as having been yielded. He does not say that "the accounts in my office show the yield to have been" so much, but that "according to some authorities" the annual yield from Asturias, Galicia, and Lusitania—chiefly from Asturias—was 20,000 Roman pounds. In round figures, and assuming the gold to have been weighed before it was refined, this was worth in modern money (that is to say, it contained the same weight of fine gold as) four million dollars. If a fourth more be added for the gold secreted by the slaves, or smuggled out of the province by the lessees of the mines in order to escape the exactions of the mint, the total would amount to five million dollars. Such an amount, if it were all that was added to the gold coin and bullion in circulation and in the mints, banks, and treasuries of the world today, would be so inadequate as to occasion profound alarm. It would be far below the annual requirement to make good the wear and tear of coin; and thus would threaten the integrity of the stock of metal, and therefore the basis of credit. But if to that of Spain there is added the auriferous product of the other Roman provinces mentioned above, the total Roman product could hardly have fallen short of forty million dollars; and this, operating upon a comparatively small stock of coin and bullion throughout the connected commercial world (which at that time scarcely went beyond the Roman pale), was quite sufficient to maintain prices and credit.

Another consideration to be held in mind was that Rome was in arms against the world and especially against those countries which possessed any substantial accumulations of the precious metals. Her accessions of gold and silver from this source, from the plunder of cities, of hoards, and even of graves, though smaller, were almost as regular as those from the mines.

The principal gold gravel mines worked by the Romans were the Sierra Nevada, Malaga; banks of the Duerna, Astorga, Leon; banks of the Sil, San Miguel, Leon; banks of the Sil, Ponferrada, Leon; Las Medulas, Las Medulas, Leon; banks of the Sil, Orense, Galicia; Cantabrian Pyrenees, Rio Burbia; banks of streams near Cordova; Guadalajara, near Madrid; banks of the Baza, near Granada; banks of the Tagus; Rio Tinto, Huelva; banks of the Burbia, near Villa Franca; banks of the Oria, near Cuevas; banks of the Eria, an affluent of the Duero; Monte Teleno, near Las Medulas, and the basin of the Guadalquiver. The principal gold quartz mines were Castropodame, San Miguel, Leon; Jadeña, 30 miles from Talavera de la Reina; San Domingo, Logroño, Old Castile; the Douro, near Oporto, Lusitania, and the gold and copper mine of Constantina, in Andalusia. The Tamaya mine, probably on the Tamega, is alluded to by Livy, but without mentioning its character. It was probably a gravel, or placer mine. The silver mines were Bebulo (now called Guadalcanal), near Cordova; Carthaga Nova, Carthagena, Murcia; the Sierra Morena mines in the mountains of Jaen; the mines in the Pyrenees mountains of Aragon; and the Rio Tinto silver and copper mines of Huelva. In addition to these, they worked the quicksilver mines of Sisapo, in Bætica, 27 miles N. N. W. from the modern Seville; and the celebrated Almaden mines of La Mancha. The Rio Tinto, Almaden, and one or two others of these ancient mines are still being worked: the first of these for copper, the second for mercury, the others for silver. Many of the ancient workings are fallen in and ruined. Castropodame proved to be a nest of snakes and a place of refuge for other unpleasant animals, some of them ready to oppose a vigorous resistance to any invasion of their domains.

The San Domingo quartz mines of Logroño, in Old Castile, were worked by the Romans in what may be termed a scientific manner. In some of them, adits were excavated for draining purposes, nearly three miles in length; whilst in others, with deep shafts, the water was raised to the surface by means of a series of gigantic wheels. Eight of these ancient wheels, all of them in a high state of preservation, have been recently found by the miners who are employed in workings contiguous to these old mines. The wheels are made of wood; the axles, where the greatest strain would come, being of oak, while the other parts are made of pine. As, in all probability, the quartz mines were not worked until the gravel mines were nearly or quite exhausted, the date of this machinery can hardly be fixed earlier than the second century of our æra. Nor, on ac-

count of known historical events, should it be fixed later than the beginning of the fourth century. About the year A. D. 200 is therefore a reasonable one for the period of the San Domingo water-wheels. They appear to have been worked on the tread-mill principle, by men standing upon one side of them, the water being raised by one wheel into a large basin and then lifted another stage by a second wheel; and so on in the same way by other wheels, until it reached the surface. In some of these ancient workings lead pipes have been found, but no iron pipes. No iron wire has yet been discovered in the ancient workings. In one of them, a wax tablet was found, containing arithmetical accounts relating to the mine; a proof that it was not worked without some regard to system and the rules of business.

The poverty of this portion of Spain is the best commentary on the present condition and availability of the mines. There are plenty of speculative miners, but no working ones. The wages of labor are pitifully low. At Priaranza, on the Duerna, the wages of farm laborers were 15 to 20 cents a day, women 8 to 10 cents; in both cases with maintenance; the latter costing 10 cents a day. Men who find their own maintenance charge 40 cents a day. They work from sunrise to sunset, except two hours for meals and a siesta in the fields. The age at which field-work is begun is from 12 to 14 for boys, and 13 to 15 for girls. Most of the latter become mothers before they attain the age of 16 or 17. At 20 they look old and worn-out; at 25 to 30 they become repulsive. The land-taxes are very heavy and form the chief source of discontent with the Government. A peasant at Las Medulas informed me that on one acre he paid $4 a year, besides 30 cents for *sedula de vicinidad* and 10 cents for each child over 14 years of age (and therefore, presumably able to till the fields). Altogether he paid $4 for land-tax and $1 for *sedulas*—a good deal of money for the owner of but one acre of land, or for a man whose labor throughout an entire year was worth only about $60: all these sums being couched in American gold coin. Besides this sum, he had also to pay customs and other indirect taxes on everything he consumed, except articles of indigenous growth; the principal commodities of foreign origin purchased by this class being hats, sashes, gew-gaws, hardware, cotton goods, sugar and spices: the silk sash and the gew-gaws probably costing more than all the rest.

THE LATEST TYPES OF INDUSTRIAL MOTOR VEHICLES.

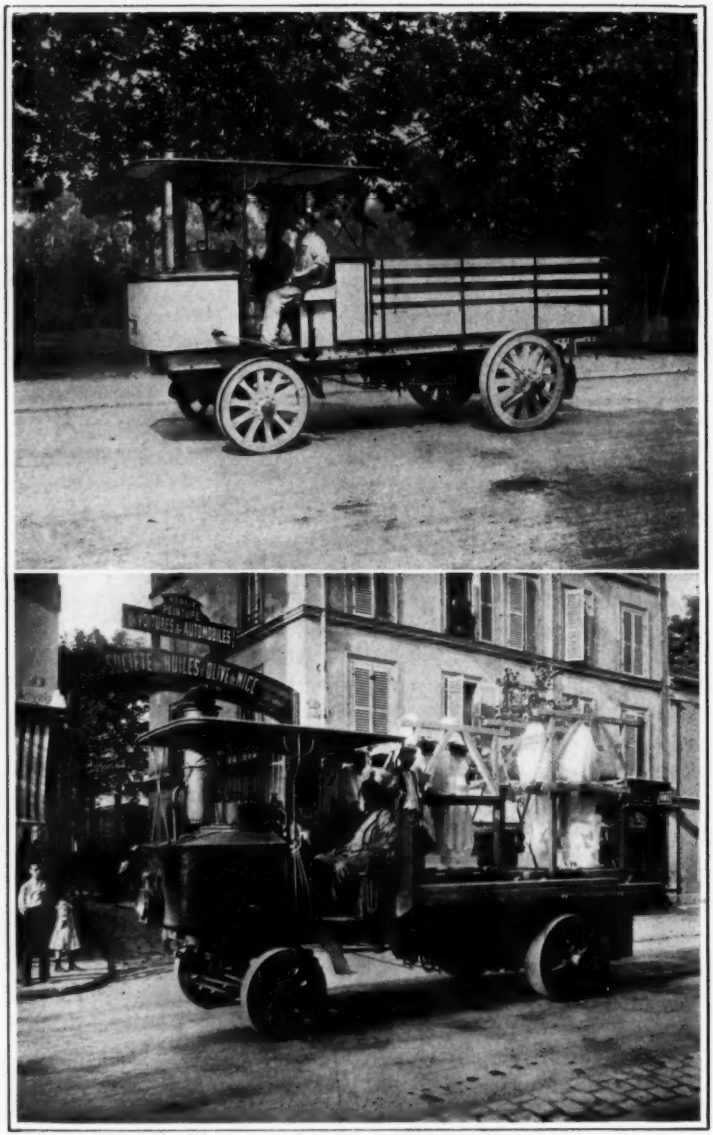
By Lucien Périssé.

Recent expositions on both sides of the Atlantic have offered opportunities to observe and to measure the advance in the construction of automobile vehicles and in their utilization in passenger and freight transportation. Monsieur Périssé is secretary of the technical committee of the Automobile Club of Paris, and he sums up the subject as it appears at present from the viewpoint of French and Continental practice and experience.—THE EDITORS.

THE industrial automobile vehicle—called in France "heavy weight" (*poids lourds*) to distinguish it from the touring or racing type—comprises two general classes, passenger and freight. With the first of these we are not now concerned. They are, indeed, of subordinate importance where the railway service is well organised and comfortable, and where city transport is amply served by electric and street railways. But these conditions may exist, as they do in the United States, coincidentally with an inadequate network for freight distribution, and with common roads far inferior to those of the Old World. Further, it is of interest to observe that experience in France has shown that while public automobiles for passenger transportation have been remunerative only under exceptional conditions, practical success has always attended the use of motor vehicles for freight in extra-urban service, opening up the traffic for the extension of the railway or tramway.

The second category, therefore—freight motor vehicles—is that to which we are to devote attention, and here the automobile appears as an admirable industrial auxiliary—a time-saver of the same class as the machine tool, the hoisting or conveying installation, or the mechanical calculating device.

It is not to be supposed that we are face-to-face with the possibility of substituting automobile for rail transport over even moderately long distances, for by far the most costly element of all in road transportation is speed. Reference to the data of the subject will show that to move one ton of useful load at 6¼ miles an hour requires 2 horse power, while at 31 miles an hour the same load demands 15 horse power. To multiply the speed by 5, we must multiply the power by 7½. It was this relation which led Monsieur G.



TWO MOTOR VEHICLES OF HEAVY TYPE, DE DION-BOUTON MANUFACTURE.

The upper one is a 30-horse-power truck; the lower, carrying marble statuary, is of 50 horse power.

Forestier, the learned secretary of the automobile section of the Exposition of 1900, to remark that no change other than that of speed was needed to realise an economy of 25 per cent. The heavy motor vehicle must rest upon its usefulness for transportation at low speeds—say 6 to 8 miles an hour; but even this is much more rapid than horse haulage, which for heavy wagons does not exceed 3 miles an hour. *

Industrial transportation by motor vehicle is most appropriate in the cases of the movement of material within very large works, or between the separate works of a single company; carriage from the factory to the railway; carriage from the factory to points of further transformation or to centres of distribution; and delivery from the factory, within the city or in its environs. In short, whether it be needed to take the yarn from spinning to weaving mill, or the woven fabric to the dye works, or the finished cloth to the railway; to transport the sugar from an out-of-town refinery to warehouses or wholesale depots; to take meat from the stockyards, or coal or ice from storage places; or to bring milk from the surrounding country into town—the heavy-load motor vehicle finds most useful application.

The light industrial automobile, on the other hand, is most useful for delivery service in or about the city—delivery of merchandise of all sorts—wearing apparel or other purchases which the buyer requires with the briefest delay, or provisions, such as milk, fish, or ice, which will not keep long; for the assemblage in one factory of material such as milk for butter or cheese making, or fruits and vegetables for preserving—in such service the light motor vehicle finds its *raison d'être* and its certain success. We may then make the following natural classification of industrial automobiles:—

1.—Heavy motor vehicles, of 2 to 5-tons useful load, and speed not exceeding 6¼ miles an hour.

2.—Light industrial automobiles, (trucks or delivery wagons) with a net-load capacity of ½ ton to 2 tons, according to the specific gravity of the material carried, the mode of packing, and the space occupied by the articles. The speed varies according to the load and the conditions of transportation, and may reach as high as from 9 to 12½ miles an hour.

On the other hand, we have a classification known to all which is based on the kind of motive power employed, and by this the vehicles are grouped into three classes—steam, liquid-fuel, and electric. We

* The speed of a draft horse is from about 1 to 2.2 miles an hour, depending upon the work he is doing.

BRITISH TYPES OF HEAVY MOTOR VEHICLES.

The upper one is a large motor truck made by the Lancashire Steam Motor Co.; the lower is a 6-ton steam motor lorry, with a 10-ton load, made by T. Coulthard & Co., Ltd., of Preston.

shall see that steam vehicles are well adapted to the requirements of the first class, above designated as "heavy," while those driven by liquid-fuel motors or by electricity are much better suited to the work of the second, or "light," class. Consideration of the advantages and disadvantages of each system may serve to determine the conditions under which the various types will be respectively best adapted to industrial use.

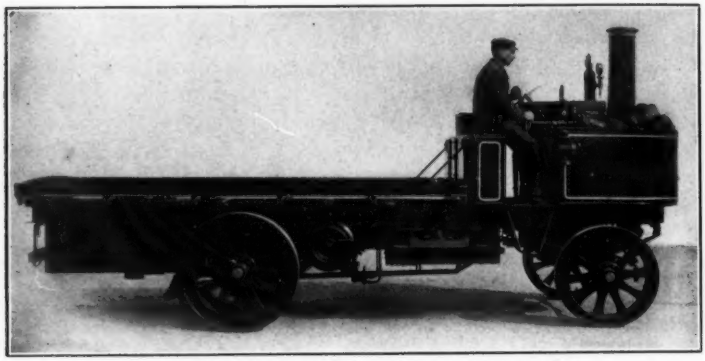
The steam automobile has essentially the quality of great elasticity. The operator can give it its maximum or its minimum power by the simple movement of a valve. If there is a stretch of bad road or a heavy grade ahead, a little turn of the throttle valve sends the vehicle forging strongly ahead under the impulse of the high-pressure steam. If, on the other hand, it is necessary to run at the slowest possible speed through a crowded thoroughfare or past a frightened horse, the throttle may be closed until the heavy wagon moves on without jar, without noise, and without danger.

Unhappily, to offset these advantages we have the fact that all steam systems of automobile propulsion involve a large dead weight, including under this term the weight of the vehicle itself and that of the motor and its supplies. Improvements have indeed been made from year to year, but they have not arrived at the point of removing the defect of damage to the roadway caused by the heavy weight on the axles and the tearing of the road surface by the driving wheels. Further, the effort has been to increase the speed, and this can be effected only by decreasing the "load efficiency."* For instance, taking the weights and the load efficiencies of the trucks exhibited by one firm at the competition of "heavy weights" organized by the Automobile Club of France, we find the following figures:—

First year.....	Total weight,	9.9	tons.	Useful load,	4.0	tons.	Load effic'y,	.44
Second year....	"	"	8.8	"	"	"	3.3	"	"	"	.31
Third year.....	"	"	7.67	"	"	"	2.4	"	"	"	.39

Reference having been made to the destructive effect upon the road surface exercised by heavy loaded trucks, it becomes of interest to cite figures furnished in 1901 by the engineers-in-chief of the Ponts et Chaussées in the various departments of France in which motor-car service has been established. In the department of Calvados, 10-ton omnibuses were run at 7.5 miles an hour; the width of the metal tires was about 5¼ inches. Although the service was infrequent, the additional expense necessary for the maintenance of the road was a little over 800 francs per mile per year. In the de-

* The coefficient of load efficiency is the ratio of the useful load to the total weight of the loaded vehicle—that is, of net to gross weight.



FLAT-BODY LORRY WITH RIM SIDES, TO CARRY 4 TONS.
Over-all length 18 ft. 3 in.; carrying body, 12 by 6 ft.; speed 5 miles on the level; a trailer carrying 2½ tons may be taken. Thornycroft Steam Wagon Co., Chiswick and Basingstoke.

partment of the Loire, motor trucks carrying a load of 3 tons were put into use on a road upon which they had to surmount a grade of 11 per cent. They showed a notable economy over animal traction during the summer season, but not enough to compensate for the heavy additional outlay, amounting to a sum varying from 1,100 to nearly 1,300 francs per mile, necessary for the maintenance of the road in winter. This was due to the lack of proper solidity in the sub-soil, and to the frequency of the service, which extended over a circuit of less than 4½ miles, the trucks passing over the road at too short intervals for its proper maintenance.

When tractor vehicles are used, it is requisite (in order that they may have sufficient adhesion) not only to make them relatively heavy, but further to provide the rim of the wheels with projections, which leave their impression in the metalled surface of the road. It is generally acknowledged that even at low speeds the deterioration caused by wheels so made is considerable. In the department of the Oise, a road locomotive weighing 12 tons was used to pull a load varying from 6 to 10 tons, according to the kind of goods. The speed was from 2¼ to 3¼ miles an hour, and the corrugated felloes, nearly 19½ inches face, caused no serious deterioration so long as the road was dry; in the wet season, however, they dug up the road badly, and it is stated further that the wheels of the trailer, though they were more than 5-inch face, cut the road into deep ruts, costly to repair. In the Côtes du Nord department a service was installed in which the tractor vehicle had driving wheels of 15¾-

inch face, the load on each being 4.3 tons; there were two trailers, of 9-tons weight, loaded. The maintenance cost of the road, which was 750 francs per mile per annum with an annual traffic of 237 horses, rose to a little over 1,100 francs after the introduction of the motor vehicles, although these replaced one-third of the draught horses formerly employed; and even this outlay had to be increased later to maintain the normal up-keep, the excess being about 350 francs per mile per annum.

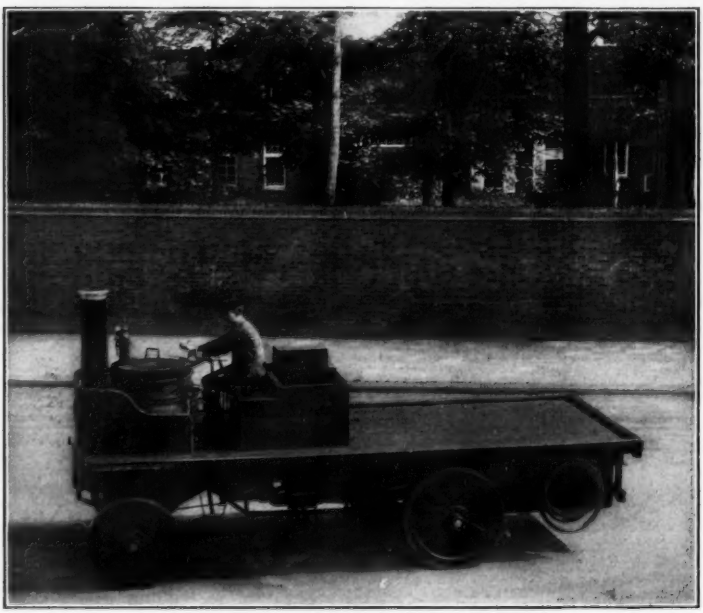
It is therefore apparent that in the use of steam vehicles, which are the heaviest yet perhaps the most convenient of all heavy weights, the primary consideration must be the roads over which they are to run. From this point of view, the lessons drawn by the British War Office from the Transvaal war seem to indicate that the steam motor vehicle is at least as serviceable on the veldt as on the open roads of civilized sections, and perhaps more so. One point is that on the veldt the trucks need not take always the same track, but may turn out from the beaten way and pick out the most convenient course; increase in the width of the face of the wheels adapted to the character of the soil will suffice to prevent their sinking in.

Among the English and French manufacturers who have attained marked success in the construction of steam vehicles, de Dion-Bouton, Purrey, the Thornycroft Steam Motor Co., and the

A 9-HORSE-POWER DE DION-BOUTON TRUCK, WITH LIQUID-FUEL MOTOR.

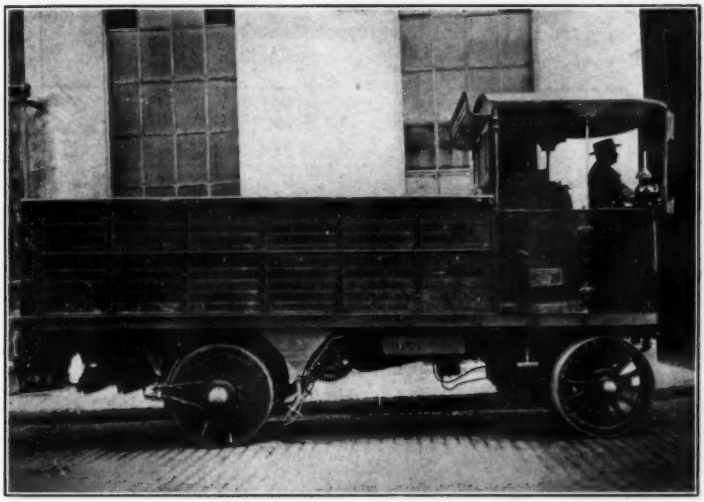
Lancashire Steam Motor Co., have devoted themselves especially to true motor trucks—that is, vehicles which themselves carry the load; the Société des Voitures à Vapeur Scotte and Monsieur Turgan, on the other hand, advocate the steam tractor, which tows loaded trailers. The mechanical features of both types are much alike—a small-tube water-tube boiler, with continuous feed; two-cylinder compound engines, placed forward under the chassis for tractors and toward the centre for trucks; transmission by gearing the rear axle or by chains to each wheel. All are designed to carry loads of 2 to 5 tons, on platforms of about 6 to 8-square-yards area. They have even been built to carry 10 tons net, but I am not at all disposed to favor these excessive weights, which involve many disadvantages.

Steam vehicles are in practical service in France and England in a great diversity of industries. In Paris may be seen a line of trucks built by Purrey, of Bordeaux, for the Say refinery. They have a closed box, for the transportation of sugar, and carry 10 tons daily. The boiler is of marine type, and the engine drives by chains the



THORNYCROFT SIDE-LOADING LORRY, TO CARRY 4 TONS.

rear wheels, which have been specially studied to carry safely the great load placed on them—about 12 tons on the rear axle. The trucks have a powerful band-friction brake. A huge van by the same builder is used to move pianos from the Pleyel manufactory.



HEAVY STEAM TRUCK FOR THE SAY REFINERY.
Carries a 10-ton load; built by Purrey.

In England, following the War-Office tests in which Thornycroft received first prize, that maker has received various orders from municipalities, from the British and German ministries of war, and from some Indian governmental administrations. In France, neither the State nor any commune has as yet taken that course, because the competitions opened have too often shown that the operating cost of the steam vehicle was too high for our budgets. Exception must be made in the case of the steam sprinkler wagon built by de Dion-Bouton, which was placed on trial last summer in the Bois de Boulogne.

It would not be surprising, moreover, if it should soon become apparent in England also that the disadvantages already referred to are a great obstacle to the development of the steam vehicle, from the point of view of economy; and the remedy is not apparent, because evidently the dead weight of the steam automobile must always be great, whatever the perfection attained in other points of its construction.

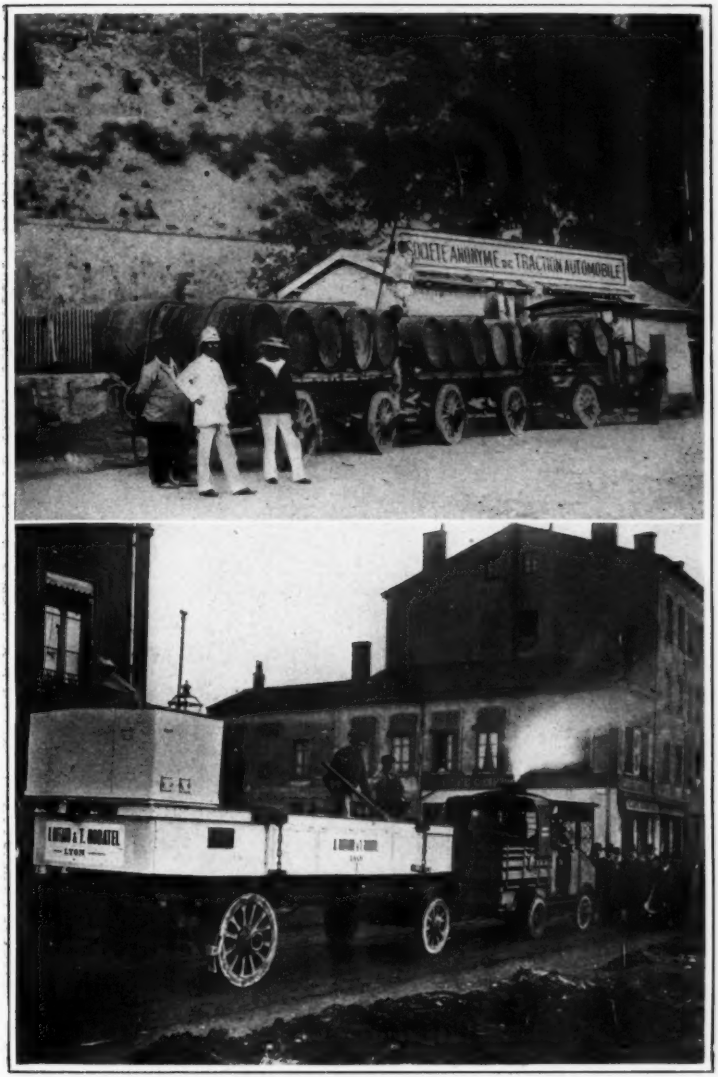
Turgan and Scotte wagons have already proved, by ample working trial, that they are reliable in operation. The artillery bureau, the department of the engineer-in-chief at Versailles, the Austrian ministry of war, various colonial offices (such as those which have charge of mines and quarries or of the vintage in Algeria), and many manufacturing and commercial establishments, have adopted the tractors of these makers.

BATTERY OF ARTILLERY LEAVING THE LISBON ARSENAL, DRAWN BY A 40-HORSE-POWER BRILLIÉ TRACTOR.

Liquid-fuel motors—which might rather be called internal-combustion-motor vehicles—both those using light hydrocarbons and those using heavy, are built by many makers; for it is easy to construct a delivery wagon carrying 600 to 1,000 pounds, or a truck carrying from 1,000 pounds to a ton, with the chassis of a touring carriage. Whenever the load passes the ton mark, however, there is ample room for the careful study of the construction of the vehicle; and from that point of view the heavy-weight section of the International Automobile Exposition at Paris, in December last, was peculiarly interesting in its exhibits of recent work and study.

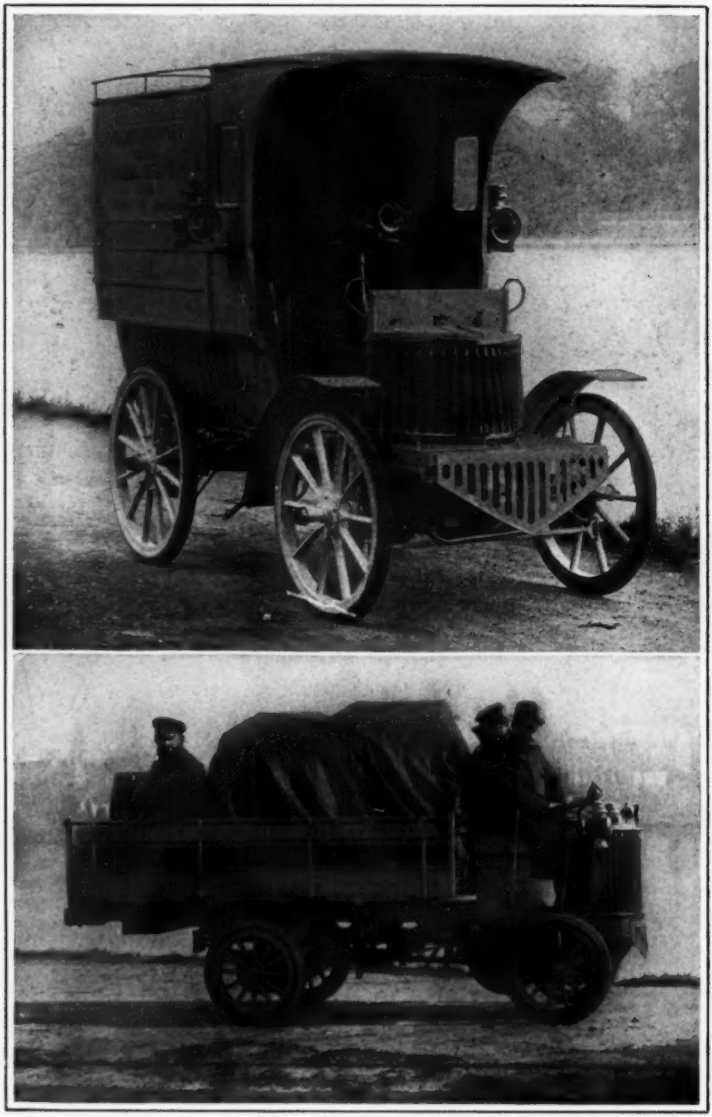
Monsieur Eugene Brillié, who has devoted a large part of his engineering career to the study of heavy motor vehicles, his automobiles being built in the artillery works at le Creusot, showed three types of trucks:—

1.—A tractor with 40-horse-power motor, for the Lisbon arsenal; this vehicle, which carries a live load of 5 tons, consisting of artillery supplies, tows a battery of large siege guns with a total weight of about 15 tons.



SCOTTE AUTOMOBILE TRAINS IN INDUSTRIAL TRANSPORTATION.

The upper one is hauling 24 hogsheads (*"demi-muids"*) weighing 19 tons, from Algerian vineyards. The lower is taking the under-body of a compressed-air tramway car, weighing about 19 tons, from the Lyons shops.

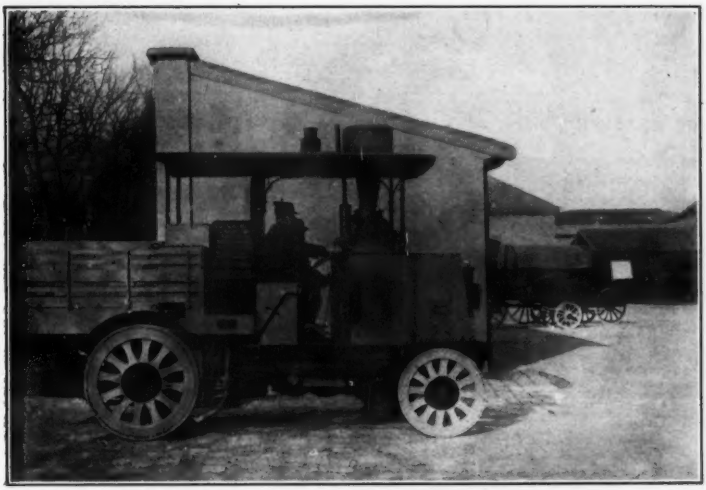


GILLET-FOREST INTERNAL-COMBUSTION-MOTOR VEHICLES OF VARIOUS TYPES.
The upper one is a delivery wagon, about 600-lb. load; the lower is a 12-horse-power truck, for a load of 2 tons.

2.—A truck with motors of 18 to 24 horse power, weighing 2¾ tons empty and carrying a load of 3½ tons.

3.—A light truck with 10 to 12-horse-power motor, carrying 2½-tons load on an empty weight of 2 tons.

The Société Française des Camions Automobiles Hagen has developed its construction, but the mechanical principles of the system remain as described in this Magazine in April, 1904. The truck exhibited was of 3-tons net weight, and carried a load of the same amount; the motor is of 14 horse power, giving a speed of 6 to 7½ miles on the level.



THE NEW SCOTTE MILITARY TRACTOR, MODEL ADOPTED BY THE FRENCH MINISTRY OF WAR.

A system which has been highly perfected during the past year is the fore-wagon of Monsieur Latil. This has the advantage over other systems of a very high load efficiency; a load of 3 tons can be carried in a vehicle weighing only half that much, giving therefore a load-efficiency factor of 0.75. The 12-horse-power motor is hung from the chassis, and transmits by universal joint to the front wheels; these, by a system of roller bearings, are made to act as both drivers and steerers. High mechanical efficiency is thus combined with complete practical utilization of the back portion of the vehicle. Thanks to this mode of arrangement, M. Latil has produced and exhibited a large van for carrying two horses, and this has just been put into use on the race-courses near Paris.

Among other builders of internal-combustion-motor vehicles for industrial use may be mentioned the Panhard-Levassor Co., Renault Bros., de Dion-Bouton, Delahaye, Peugeot, etc. The Société Gillet-Forest has retained the horizontal motor, permitting an excellent utilization of the surface of the chassis. This company is now contemplating a large automobile-carriage installation in Paris.

In this connection it is interesting to give the daily operating costs of two of the most frequently employed types of commercial vehicles. Type A is the small delivery wagon with 7 or 8-horse-power motor, carrying a maximum load of about a ton. Type B is the large van with 12-horse-power motor, a cubic capacity of 6 to 7 cubic yards, and a load-limit of about 1½ tons. We will assume a useful daily travel of 37½ miles. Garage is included in the general expense item, but in many cases garage will be secured on the shop or factory premises, and will therefore cost nothing.

	Type A francs	Type B francs
Gasoline (9½ and 14½ centimes a mile)..	3.60	5.40
Lubricating oil	1.00	1.10
Tires (9½ and 11½ centimes a mile)....	3.60	4.20
Repairs (9½ and 11½ centimes a mile)..	3.60	4.20
Motor man *(Mécanicien-conducteur)*.. ..	5.00	5.00
General expense, insurance, washing.....	2.10	2.40
Sinking fund	3.00	3.60
Total daily running expense	21.90	25.90

These figures, which of course apply to Paris, are notably lower than horse traction in that city.

Colonel Renard's continuous-propulsion road train, which we considered last year from the mechanical point of view on the appearance of the first specimen in the Exposition of 1903, was this year represented by a series of vehicles designed for the great butter-shipping enterprise of Messrs. Bretel Bros., of Valognes, Manche. The locomotors are equipped with 50-horse-power Abeille motors, tested for more than 100 consecutive hours by the windmill dynamometer. Great improvements have been made in the passenger vehicles by the adoption of a six-wheel type which permits good utilization of the chassis. Several industrial installations of the Renard road train are now under way toward organization in France.

CONTINUOUS-PROPULSION AUTOMOBILE TRAIN, RENARD SYSTEM.
50-horse-power liquid-fuel motor; net load 20 tons.

Important industrial use of automobile vehicles has been made in the French colonies, and notably in Madagascar. It may be of interest to survey them rapidly.

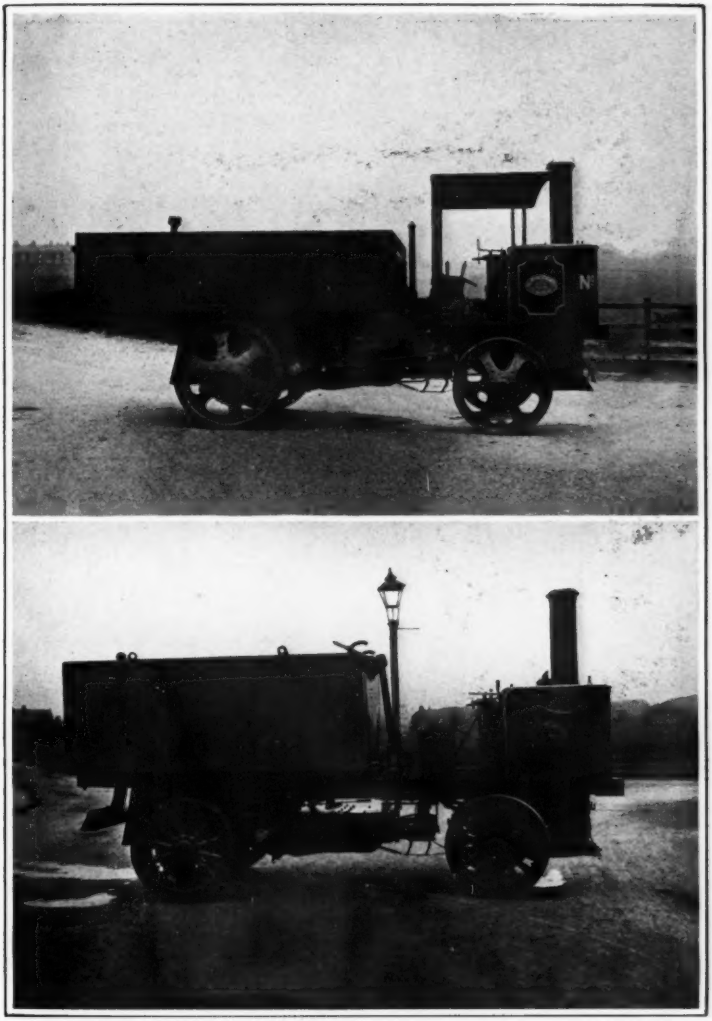
In the early months of the year 1900, General Gallieni, governor of Madagascar, took out with him three Panhard-Levassor cars, and the first trials were made before the completion of the road from Beforona to Tananarivo. This road was finished January 1, 1901, and Captain Grüss, ordnance officer to the governor, was at once charged with the organization of a regular service. Trial trips were arranged, the supply service organized, and the improvement of the road carried on until on May 20, 1903, an order of the governor instituted the mail service between Mahatsara and Tananarivo which went into operation June 1 following. In 1904 Captain Grüss made a most interesting detailed report; from this it appears that the road followed between Mahatsara and Tananarivo is 155 miles long and runs through mountainous country, with many curves but with maximum grades of 9 per cent only. The "rolling stock" consists of six automobile trucks of 15 horse power, and two 12-horse-power brakes, all of Panhard-Levassor make. Ordinary mails weigh from 1,300 to 1,800 pounds, but the French mail attains a weight of 5,500 to 6,500 pounds and the eight automobiles are sometimes overloaded and require thorough inspection after each trip.

The automobile drivers are colonial soldiers, almost all machinists by trade, and their apprenticeship on the road has been so carefully directed that each vehicle can be safely trusted to the one operator aided by a single Malagassy assistant. Repair shops and stores of repair parts are distributed along the road, as well as gasoline-charging stations. The 15-horse-power vehicles are arranged to carry four passengers, and in addition to officers and officials, many persons apply for passage on the automobiles, although the two-day trip to Tananarivo costs 192 francs, while the same journey may be made in native vehicle *(pousse-pousse)* in five days at a cost of only 150 francs.

In seven months the motor vehicles made a mileage of 28,500 and carried 106 tons of mail, 185 passengers, and 7 tons of personal baggage. The total net cost was 89,000 francs. The running expenses were therefore 5.40 francs per ton mile, or 840 francs per ton for the carriage of the mail the whole distance of about 155 miles to Tananarivo. For the same service, individual contractors were formerly paid 1,000 francs a ton, and the journey occupied five or six days. The transport by automobile is therefore advantageous from a pecuniary standpoint, as well as in the matter of time. Pending the completion of the railway, of which a 60-mile section was opened November 1, 1904, the automobiles will keep Tananarivo in regular and quick communication with the coast.

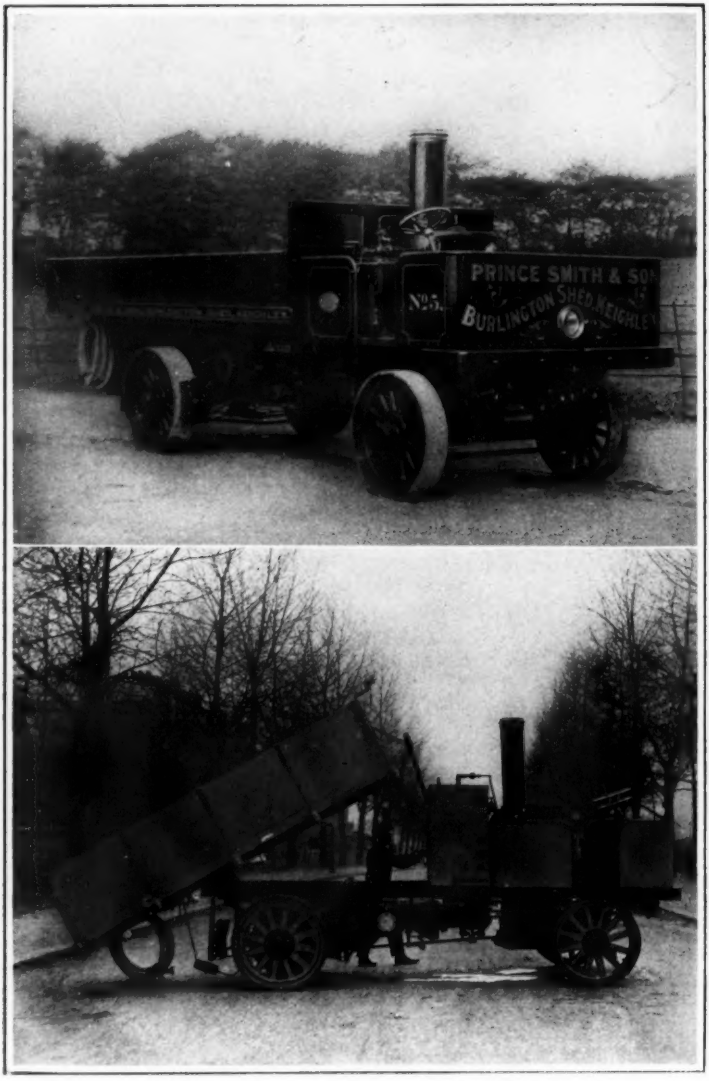
Of electric automobiles I shall speak but briefly; the number employed in France is limited to the city delivery wagons of establishments such as the Louvre and the Bon Marché, which are placed on an ordinary electric-carriage chassis. Electric vehicles for industrial purposes, in fact, have not come into use even where power could be obtained at very low cost, partly because the dead weight is considerable—larger even than in the steam vehicle—and partly because the maintenance of modern accumulator batteries is very burdensome, especially in the case of vehicles subject to the vibration, the jolting, and the shocks of city-street travel. Nevertheless, it ought to be said the Société des Automobiles Krieger and Messrs Mildé & Co. build electric delivery wagons which give excellent service in any case in which the rather high running expense is offset by the advantages of the very smooth running of the vehicle.

The Krieger company show a gasoline-electric truck—that is, one in which a gasoline motor drives a dynamo from which current is distributed to motors driving each wheel. The generating set may be used for operating a large search light when the truck is at rest.



MOTOR VEHICLES BUILT BY THE LANCASHIRE STEAM MOTOR CO.

The lower one is a convertible tip-wagon and watering van, 5-ton or 1,000-gallons capacity; 8-in. weldless steel tyres, wheels chain driven through the spokes, internal expanding brakes. The upper figure is a 4-ton colonial wagon, body steel-lined, wheels steel throughout; fire-tube boiler.



RECENT TYPES OF COULTHARD MOTOR VEHICLES.

The upper one is a 6-ton steam-motor wagon; the lower is a 4-ton steam-motor tipping vehicle.

The Paris post office also introduced, in 1904, a large number of high-speed vans for the rapid handling of the mails within the city. In brief, the construction of electric automobile vehicles has reached a point of such perfection that they may be employed with entire safety for delivery wagons up to 3½-tons total weight. Beyond that, the internal-combustion-motor type becomes the most advantageous.

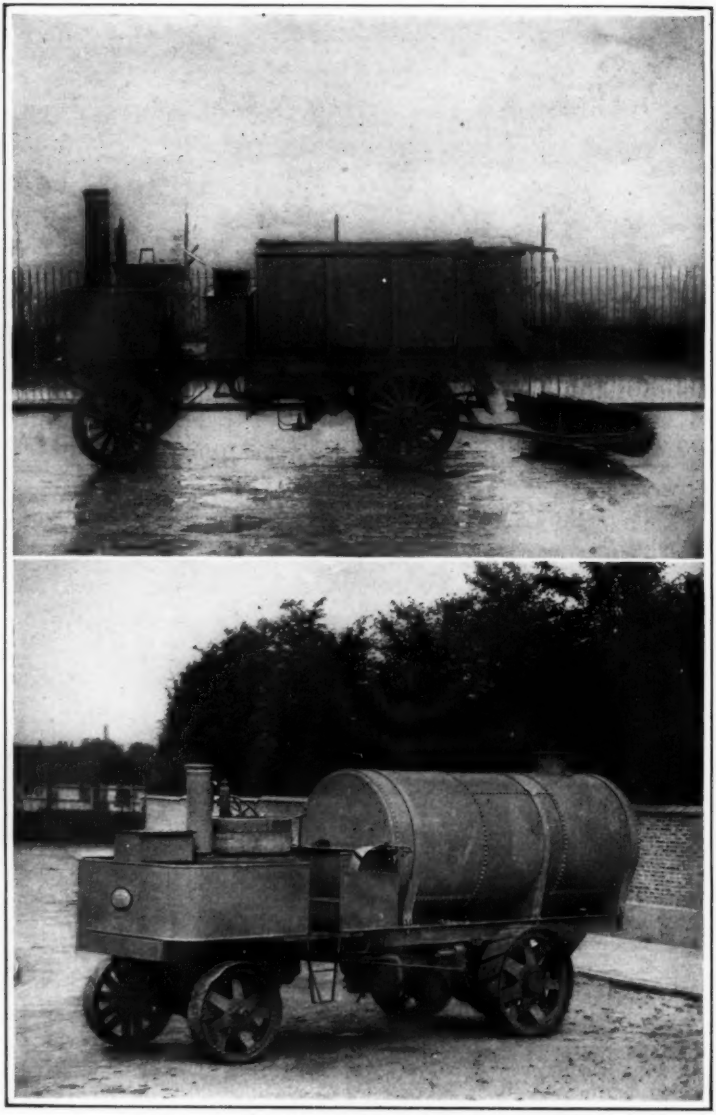
The automobile has become available as an industrial-transport agent because its construction has been perfected to the point where certainty of operation and of running can be guaranteed. Progress in the manufacture of liquid-fuel vehicles, moreover, assures a large reduction in the item of repairs (which constitutes an important element in the running expense) and for these reasons:—

1.—The metals employed in automobile construction have been selected by the results of long experience, and they have a higher resistance with smaller weight than was obtainable formerly. Nickel and tungsten steels, nickel itself, phosphor bronze, the alloys of aluminium—these are constantly used now for parts requiring special strength or special lightness. These improvements have been perfected through the knowledge gained in the great races organized in France, which inspired and stimulated studies by which the whole automobile industry is now profiting.

2.—Modern high-class machine tools, of which a very large proportion are of American origin, permit the mechanical production of parts with great accuracy and absolute interchangeability—an essential condition of manufacturing on a large scale.

3.—Finally, the arrangement of the various parts is now determined by the principles of an exact experimental science, quite sufficiently developed to dictate certain general types as combining the best economy in manufacture with the greatest facility for inspection, maintenance, and repair. Intending users need no longer be deterred, as they have been too often in the past, by the annoyances of a badly placed screw, or a spark coil continually out of order. Again it is to the races, and especially to the English "Reliability Trials," that we owe the important advances toward perfection made in the last few years.

Liquid-fuel vehicles may be replaced by electric within city limits, where cost of operation is subordinated to other considerations. For the transportation of heavy merchandise, which is requisite in certain industries, recourse must be had to steam; but this demands very firm roads, and in any case it is prudent to limit the speed to



THORNYCROFT STEAM WAGONS FOR SPECIAL PURPOSES.

The upper one is a street-watering and sprinkling wagon; the 700-gallon tank is interchangeable with a tipping body. The sweeper is removable, or replaceable by a squeegee. The lower picture shows a tank wagon to carry up to 7-tons load.

6 miles an hour on the level and the weight to 3 tons on any one axle, so as to limit the deterioration of the road to a figure compatible with industrial economy.

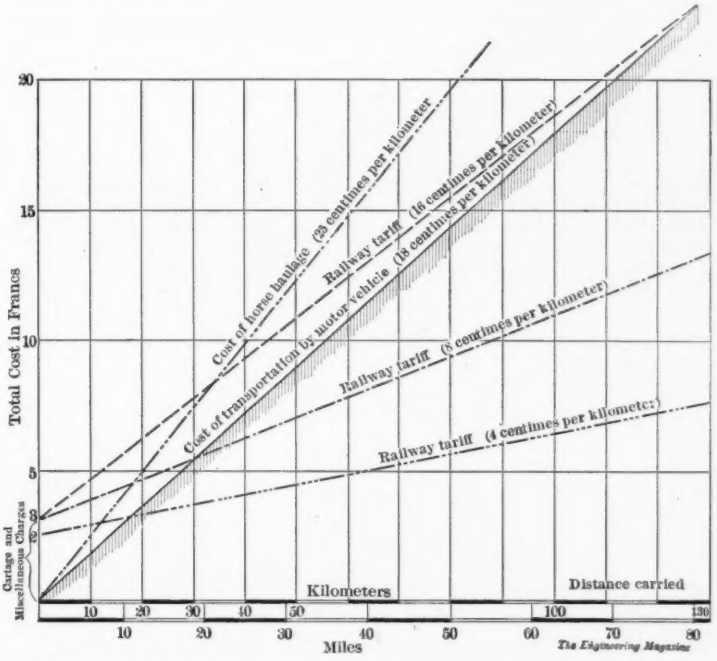

Total Cost in Francs
20
15
10
5
Garage and Miscellaneous Charges
Cost of horse haulage (23 centimes per kilometer)
Railway tariff (16 centimes per kilometer)
Cost of transportation by motor vehicle (18 centimes per kilometer)
Railway tariff (8 centimes per kilometer)
Railway tariff (4 centimes per kilometer)
Kilometers
Distance carried
10 20 30 40 50 100 130
10 20 30 40 50 60 70 80
Miles
The Engineering Magazine

CHART OF RELATIVE ECONOMY OF TRANSPORTATION BY VARIOUS AGENCIES.

In any comparison of transportation costs, as between the automobile and the railway, it must be borne in mind that railway carriage implies trucking to and from the station, and incidental charges for storage, etc., which average in the total two or three francs per ton on all classes of merchandise. It then becomes plain that up to a certain distance the automobile which carries the goods from door to door must be the most economical. I shall not attempt to give absolute figures, for railway tariffs in different countries differ widely according to the circumstances of the business, the districts, and the weight hauled. In France there are three tariffs, 4, 8, and 16 centimes per ton per kilometre (about 6½, 13, and 26 centimes per ton per mile); platting, on a graphic chart, curves based on these figures and putting in curves for the automobile and

for horse haulage—the former at 18 centimes and the latter at 25 centimes per ton per kilometre (29 and 40 centimes per ton per mile) we obtain the results shown in the accompanying figure. Carriage by automobile is more economical than carriage by rail, at any particular tariff, up to the distance represented by the point at which the curve corresponding to that tariff enters the shaded area of the "domain of the automobile."

It is thus apparent that for merchandise paying the railway tariff of 4 centimes per ton per kilometre, carriage by automobile is the more economical up to a distance of 18 kilometres (11¼ miles); on the 8-centime per ton per kilometre tariff, the automobile is the more economical up to 30 kilometres (18½ miles); and on the 16-centime tariff, the automobile holds the advantage in economy up to 130 kilometres (81 miles).*

It is therefore plainly impossible to say absolutely that transportation of goods by automobile is more economical or less economical than similar carriage by rail. Manufacturers must study the particular conditions by which they are confronted, and it is only by taking these all into account that the solution of any particular case can be determined.

There is, however, no question whatever that mechanically propelled road vehicles are now potential utilities of the utmost value to the manufacturing industries, and that the occasions for their profitable employment will become the more frequent as manufacturers become better informed of the agencies at their command, and as automobile builders acquaint themselves more fully with the indispensable conditions of economical industrial transportation.

* Under similar conditions the limits of economy in horse haulage, as compared with the railway at the three tariffs mentioned, lie at 12, 19, and 34 kilometres.

THE STORES METHODS OF THE POND MACHINE-TOOL WORKS.

By Horace Lucian Arnold.

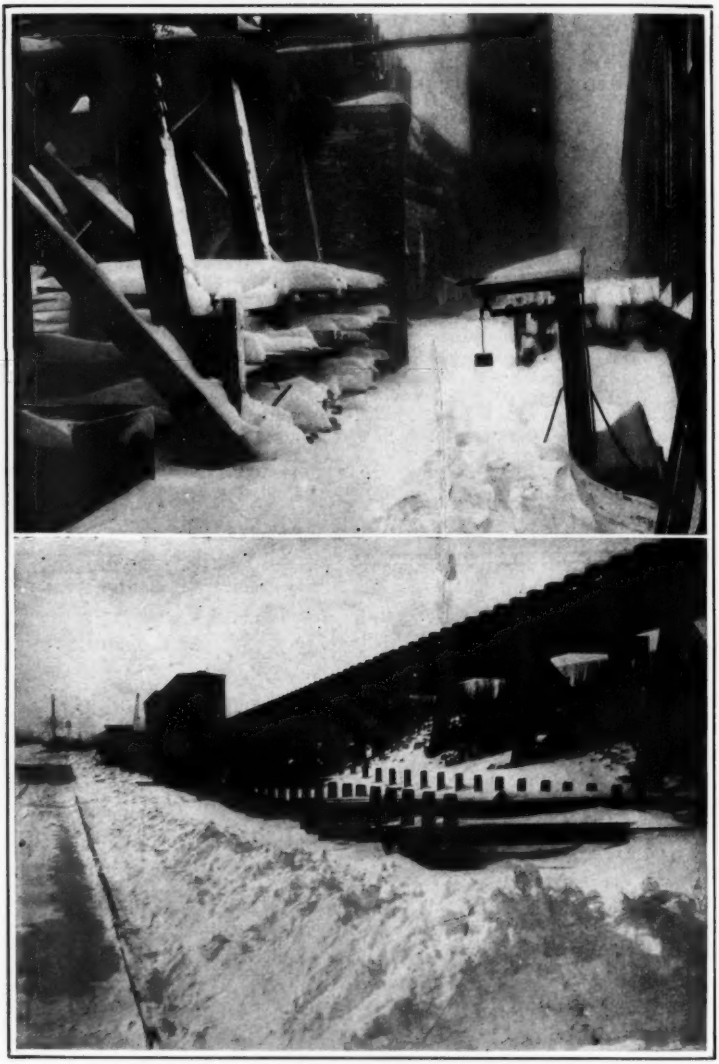
The stores department is generally acknowledged among shop managers to be that upon which the least satisfactory conclusions have been reached in the matter of reorganization and modernization. With a hope of leading in the formation of a better practice and a fuller literature in this field, as we have had the privilege of doing in the field of cost keeping, THE ENGINEERING MAGAZINE has undertaken the publication of a series of articles descriptive of the working methods of a number of shops. The first of the group appears below. The Pond shops are selected for their known and established success. Their stores system represents the result of gradual growth and expansion, with successive expedient adaptations to meet incoming conditions, but with no radical attack upon the problem of devising a system for a large shop.—THE EDITORS.

THE Pond machine shop, in which the rough-stores room and the finished-stores room are included, is 1,007 feet long by 100 feet wide. The rough-stores room is at the extreme western end, and the finished-stores room at the extreme eastern end of the machine shop, which does not stand exactly east and west.

The rough-stores room occupies the northwest corner, approximately, of the machine-shop floor, taking in about 40-feet square, with racks and bins on the east, and stores-keeper's office and castings floors on the west.

There is a flush 24-ton scale platform, with railway track on it, between the rough-stores office and the racks and bins, and a 3,000-pound platform scale on wheels on the castings floor just north of the office, next the west wall. A small scale on a bracket against the bin frame completes the stores-keeper's weighing outfit, and a small lever shear, two power hack-saws and cutting-off machines, all near the small round-stock rack and bins, complete the stores-keeper's weighing and cutting machinery.

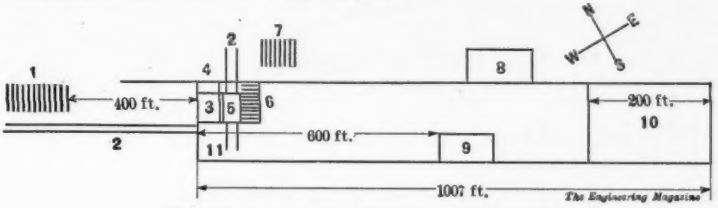
Rough Stores Placing.—Small bars are racked under the second floor of the bins and shelves; this floor is reached by a short flight of stairs. Round and flat iron and steel in medium sizes are racked close to the stores room, out-doors, on the north side of the shop. The small sizes of round machine steel, up to 1½-inches diameter, are racked in the stores room, as shown in illustration. The larger sizes of steel and iron bars are racked out of doors, about 400 feet



OUT-OF-DOOR RACKS FOR IRON AND STEEL BARS.

The set in the lower picture are for heavy bars (space 1 in plan); those in the upper one are for medium and light bars (space 7 in plan). The views, taken after the snowstorm of January 25, suggest some disadvantages of out-door storage.

west of the stores-keeper's office, between a railway track running into the works and an elevated railway trestle, these heavy steel-bars racks being replenished by an Industrial Works locomotive crane, which moves on the railway track as required. The round bars racked outside may run from 50 to 100 tons in quantity, according to the stage of replenishment. This stock is delivered by the railway, and unloaded to the racks by the locomotive crane. A plan sketch of the works is given, which will enable the reader to understand the lines of stores delivery.



SKETCH PLAN OF THE POND MACHINE SHOPS.

1, heavy iron and steel bars, 400 ft. west of rough-stores room; 2, 2, railway tracks into shop; 3, rough-stores keeper's office; 4, castings floor; 5, scale platform, 24 tons; 6, two floors of boxes and light-bars rack; 7, medium-bars racks, out of doors; 8, drawing room; 9, main offices, Head, factory accountant, and finished-stores keeper; 10, finished stores; 11, boxing and shipping.

Rough-Stores-Keeper's Force.—Rough stores are delivered by the rough-stores keeper to the iron foundry, the smithy, the machine shop, and the boxing and shipping floor.

The stores keeper has three clerks and one trucker; several other truckers are used in the foundry and machine shop, some of whom are Africans. One of the clerks is the "record clerk," or stores-keeper's accountant, one is the castings clerk, and one is the forgings clerk.

The record clerk, or store's accountant, records all stores, receipts, and disbursements, except iron castings.

The castings clerk records the receipts of all castings, no matter where made of what material, on Forms 6; the Pond Company operates a large foundry and makes its own iron and semi-steel castings. These are kept in the yard out of doors, when made in advance of shop demands, or are sent directly to the stores keeper, who weighs and charges them to production orders, and delivers them—if small, by truckers; if large, on cars to the traveling cranes. The main floor is covered by four large electric traveling cranes, the south side has two smaller traveling electrics, and the north side, one.

The forgings clerk reports deliveries of iron and steel bars on Forms 8, and makes miscellaneous deliveries, recorded on Forms 7.

FOUNDRY TRUCKMAN, TAKING A LOAD OF CASTINGS FROM ROUGH-STORES CASTINGS CLERK TO MACHINE-SHOP CONSTRUCTOR.

Books Kept by Rough-Stores Keepers. —1. List of shop orders; large bound volume.

2. Stores-record books, separate volumes, filled from Forms 9.

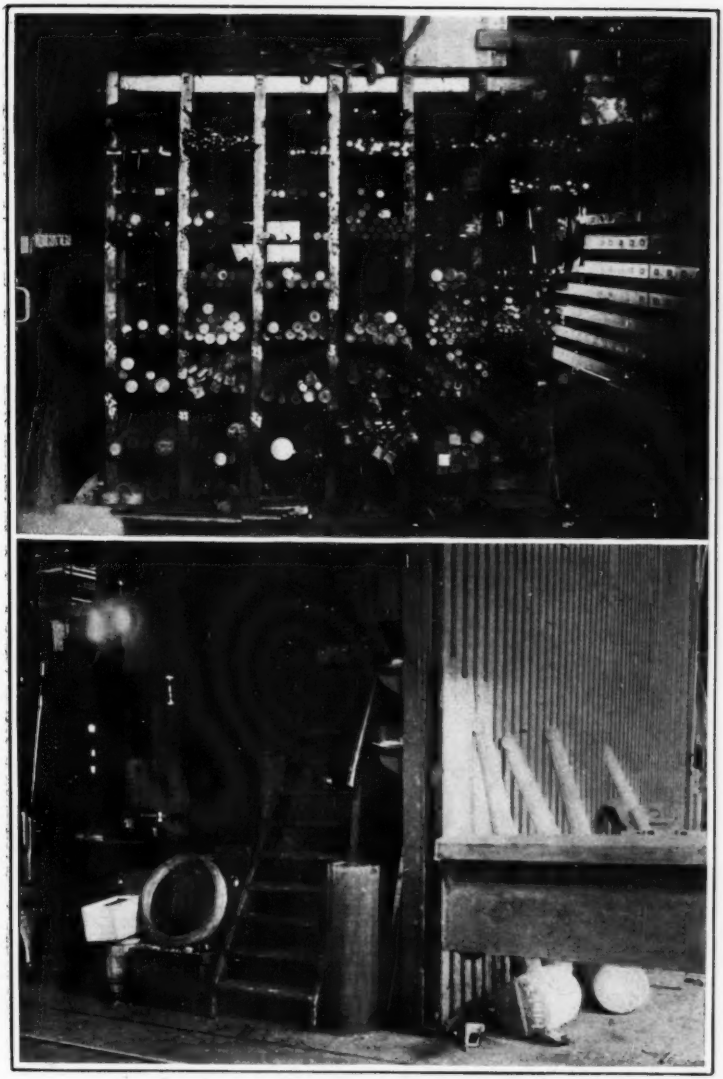
Eight of these are in use, Tengwall binders to take sheets 14 inches long by 10 inches high; Book A records screw disbursements; B, tool and machinery steel bars; C, nuts, washers, steel, iron and fiber, woodruff keys, oil cups, bushings, oil pipes, chains, shear blades, carriage and machine bolts, and lag screws; D, miscellaneous; E, composition castings; F, pig and scrap iron, steel springs, steel plates, steel forgings, cap screws, round and flat iron; G, pipe fittings and pipes, steel castings, and additional screws; H, composition castings, files, drills, taps, and wood-screws. These eight books are made up of Forms 9, stores-record sheets, on which stores disbursements are recorded, charged against their respective order numbers—the "bin number," "sample number," or "piece symbol" being used, as taken from the "sample-number index book" in making all stores disbursements charges on Forms 3A, which are printed the same on both sides. (See illustration, "Form 9."

3. Office orders. Letter press copy book, copies of Form 1.

4. Day-book record of rough stores received from all suppliers, factory and outside. Gives the rough-stores keeper a date record, and is his warrant for certifying bills payable to outside suppliers.

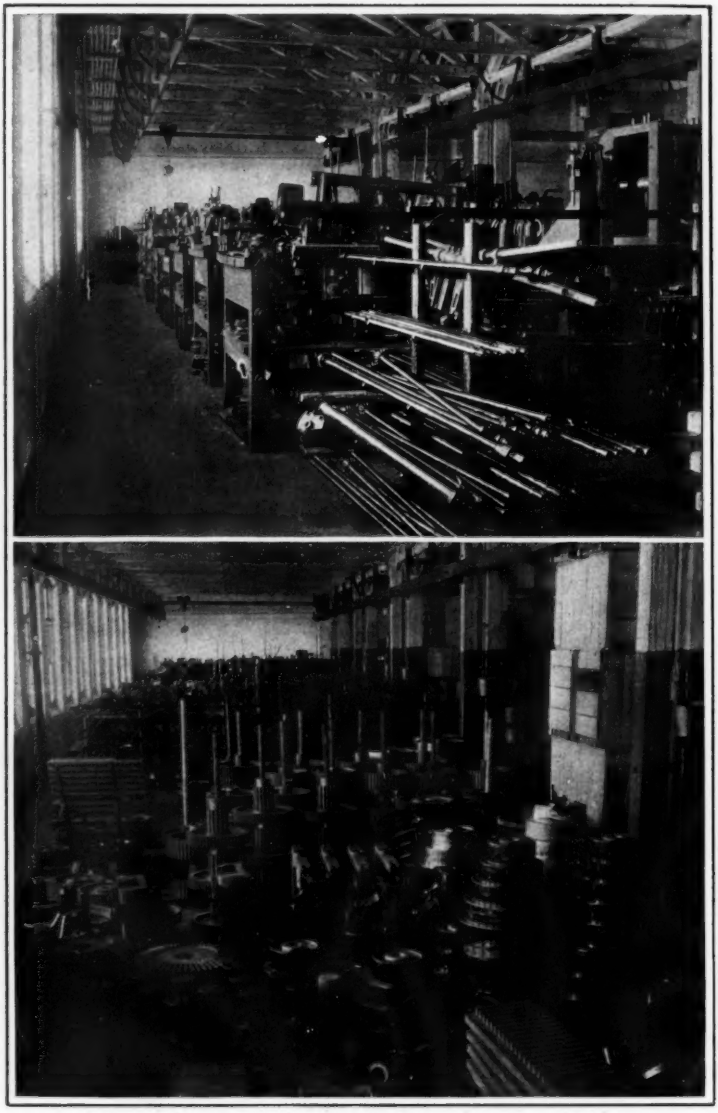
5. Letter copy book;

ROUGH-STORES-KEEPER'S DESK.
Space 3 in plan.



DETAILS OF ROUGH STORES, SPACE 6 IN PLAN ON PAGE 921.

The floor in the lower picture is the platform of the scales. The stairs lead to the top bins. This is the entrance to the rough stores from the machine shop. The upper picture shows light bars racked under the top-floor bins.



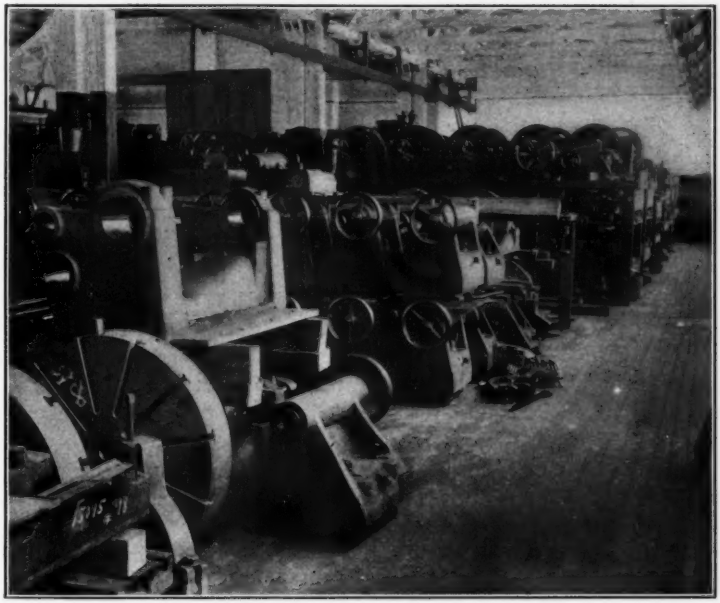
SECTIONS OF THE FINISHED STORES, SPACE 10, PLAN ON PAGE 921.

The lower view shows large finished components; the upper, other portions of the finished stores, racks, and shelves, North East corner of the machine shop.

letters to hurry outside supplies, written on regular letter heads.

6. Drayman's receipts, stub book, Form 11.

Bin Numbers.—The rough-stores room has about 1,500 separate bins, of which about 900 have individual consecutive numbers, known as "sample" numbers. Each "sample number" designates a particular component, as "Sample 376," which is a square-head cap screw, 5 inches long by 1⅛ inches diameter.



FINISHED STORES (SOUTH SIDE OF SPACE 10, IN PLAN).

Sample-Number Index Book.—This is a scrap-book 6½ inches high by 4 inches wide, made up of small blue-print sheets of small-scale drawings and size specifications of screws, nuts, washers, keys, and pins. Duplicate copies of this "index book" are kept in the drawing room, and many of the foremen also have copies. "Sample-number" would legitimately translate into "piece (or part) symbol," and when written calls for a certain kind of a piece of fixed dimensions. "Sample numbers" and "bin numbers" are two terms for the same thing. A "bin number" is a "sample number" painted on a card and the card nailed on the bin containing the article specified.

The "Order-Number Stores-Room Requisition."—When the drawings for an "order"—that is, a production—are completed, two or three "supply-sheet" tracings are made, one each for castings, forgings, and stores supplies; or, where there are only a few parts, "forgings" and "stores supplies" are combined on one sheet of tracing. Blue prints from these supply-sheet tracings go to the rough-stores room, the construction foreman, and the factory accountant.

"Stock"-Record Sheets or Stores-Record Sheets.—"Stock" and "stock-room" are used at the Pond shops for stores and stores room. The title of this form is properly "stores-disbursement charges." The title here used is "stores record."

Rough-Stores Replenishments.—The rough-stores keeper is also the purchase agent, and the finished-stores keeper is also the shipping clerk. The tool-room foreman is made the tool-steel-bars and rods keeper.

All rough-stores replenishments are made by orders to suppliers, filled by the rough "stores keeper, acting as purchase agent, on Forms 1, which see,

Form 1 is the only purchase form used by the Pond Machine Co., and is filled for purchases of all replenishments and supplies, of every description. These forms are kept by the general stenographer in the main office. About 3 p. m. each day this stenographer reports at the rough-stores-keeper's office, about 600 feet from the stenographer's office, and writes the stores-keeper's orders for the day in short-hand; he then takes them to his own office, 600 feet return, and there fills Forms 1 to satisfy the rough-stores-keeper's requisitions, one copy only for each supplier for the same order date. "S. O." stands for "shop order," meaning "production order," and in case the requisition is to be charged directly and solely to a single S. O., this S. O. number follows the specification line, as, in the case of Form 1, filled to a supplier of steel-castings, "B2-24-Steel Castings, P-26427-S. O. 28552." "B2-4-Steel Castings, P-26426-S. O. 28734," P. 26427 and P. 26426 being pattern numbers.

On the day of filling the stenographer sends the order to the Head, in this case Mr. Stebbins, who vises the order and vivifies it by adding his signature.

Foundry rough-stores are commonly placed in charge of the foundry superintendent. The Pond procedure is as follows, the rough-stores keeper acting as purchase agent and delivering his foundry-supply purchases in bulk directly to the foundry superintendent.

SEND MONTHLY STATEMENT TO PLAINFIELD OFFICE.

THE POND MACHINE TOOL CO.

NILES-BEMENT-POND CO. SUCCESSOR

Order No. 32524 *Plainfield, N. J.,* Jan 24 190 5

To Pratt and Whitney Co
Tools and Hartford Conn
Fixtures

Please furnish us the goods specified below

Ship by _____ *at lowest contract rate. Send* DUPLICATE INVOICES *and Bill of Lading, for* each *lot of goods delivered. Mark Invoice and goods with above order number. Acknowledge receipt of order and state when you will ship.*

1-Taper Reamer, No 11, 6in Taper 1in, 1sn 12ms
as per Blue print E-1073. Ewendorth.

Yours Truly,
The Pond Mach. Tool Co.
Per. A. C. Stebbins, V.P.

C.E.G/f
1 Enclo

Filled _____ 190___

As per Invoice of _____

The Engineering Magazine

FORM I, ROUGH STORES. ORDER TO SUPPLIER.

Printed in copying ink, on white paper; 8¼ by 11 inches.

Foundry Rough Stores.—Foundry replenishments are made by the rough stores-keeper's dictation to the office stenographer (See Form 1, caption). Sand, facing, flour, nails, brushes, rosin, and all minor foundry supplies go directly into the keeping of the foundry superintendent and are charged in the lump to the foundry expense, and disbursed by the foundry superintendent to workmen with no

check or memorandum. Foundry fuel is treated in the same manner, the coal, coke, and wood being charged to expense and delivered to the foundry superintendent, who keeps individual heat and cupola accounts of fuel used and metals charged. The rough-stores keeper weighs the loaded coal cars as received, on a track scale located about 500 feet west of the machine shop, and weighs the empty cars after unloading, crediting the difference in weights to the supplier.

The foundry metal supplies, pig and scrap iron, are purchased on the superintendent's requisition on the rough-stores keeper, using Form 2, and when received are piled near the foundry, where they are subject to the superintendent's order to the melter; the original memorandum of the melter's daily charging weights and materials is sent to the works accountant through the rough-stores-keeper's office, where a memorandum is made of the pounds of pig iron and pounds of scrap used for the day, with no reference to order numbers. A separate account is kept with each cupola, on form blanks 4 which see, with caption.

Order No._____

*Name*_____

*From*_____

RECEIVED

Date.	Lbs.	Date.	Lbs.

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FORM 2, ROUGH-STORES-KEEPER'S RECEIPT FOR FOUNDRY-SUPPLY METALS. Stiff manila card, 6 in. square; ruled in red and printed in black. Form 3 is precisely similar, except that the word "Received" is replaced by "Taken Out."

Form 2 is the rough-stores keeper's receipt for foundry-supply metals only—pig and scrap irons, received from suppliers in response to orders made on Form 1.

Form 3 is used to record the melter's daily requisitions for each cupola in blast. Forms 2 and 3 are tacked one on each side of a thin board, same size, and this "target" is kept in a covered box

fixed adjacent to any out-of-doors pile of pig iron, or scrap, foundry stores. Form 2 is filled by the rough-stores keeper when material is added to stores on hand, the previous Form 2 being removed from the target and sent to the factory accountant.

Form 3 is nailed to the target blank, when a new Form 2 is fixed to the target. Forms 3 are filled daily by the foundry clerk to satisfy the melter's requisitions. Forms 2 and 3 are removed together and sent to the factory accountant upon receipt of a pig-iron or scrap-iron replenishment.

The individual cupola charges and productions are recorded on Forms 4.

The daily memorandum of castings is filled in by the castings clerk on Form 5, delivered to the stores keeper, and held in the stores room as long as it is useful. Form 6 is filled out from the daily records of Form 5, and serves to fix the date of the receipt, by the stores room, of individual components—often an important matter. Form 7 is the stores-room delivery-clerk's component charge sheet against production-order numbers, filled out by him from Forms A9 and B9, valued by the stores-room accountant, and sent in daily to the factory accountant. Form 8 is similar, but applied

The Pond Machine Tool Co.
NILES-BEMENT-POND CO., SUCCESSOR

Report of Heat in _____ *Cupola*
_____ 190

Pig Iron.		lbs.
		"
		"
		"
		"
	Total Pig,	"
Scrap.		"
		"
		"
Waste.		"
Total Scrap and Waste,		"
Total Iron Charged,		"
Fuel.	Coal,	lbs.
	Coke,	"
	Total Fuel,	"
Flux.		lbs.
	Total,	"
		"
		"

PRODUCT

Perfect Castings,	lbs.
Imperfect "	"
Waste.	"
Total Product,	"
Loss in Melting,	"
	"

The Engineering Magazine

FORM 4. INDIVIDUAL CUPOLA RECORD. Filled from the melter's reports by the foundry clerk, and sent by him to the rough-stores keeper, one day late. Kept until castings clerk can weigh the castings produced and so fill the credit spaces under "Product"; then sent to factory accountant. Form is 4 by 11 in., white paper.

Castings Received _____ 1 _____

REMARKS.	No. of Pcs.	Order No.	Pattern No.	Weight.

The Engineering Magazine

FORM 5. STORES-KEEPER'S DAILY MEMORANDUM OF CASTINGS RECEIVED.

Filled by castings clerk, and held by stores room as long as useful. Supplies the data for Form 6. 8¼ in. wide by 10 in. high, white paper, blocked in pads.

Report of FOUNDRY CASTINGS.

DELIVERED TO MACHINE SHOP

_____ 190

FOR ORDER NO.	SYMBOL NO.	QUANTITY AND DESCRIPTION	WEIGHT	PRICE	AMOUNT	CLASS OF WORK

The Engineering Magazine

FORM 6. INDIVIDUAL CASTINGS-COMPONENT CHARGE RECORD AGAINST PRODUCTION-ORDER NUMBERS.

Filled by rough-stores castings clerk as castings are sent to constructing or erecting foremen, and sent daily by stores keeper to factory accountant. Manila paper, 8½ in. high by 13 in. wide. The cut shows the column headings and mode of ruling, in reduced scale. Forms 7 and 8 are identical in every way, except the former is headed "Store-Room Report of Miscellaneous Material and Supplies Delivered to Machine Shop," and the latter "Store-Room Report of Bar Iron and Steel Delivered to Machine Shop"; these are filled by the stores-room delivery clerk from Forms A9 and B9, examined and valued by the stores-room accountant, and by him sent in daily, with values fixed in detail, to the factory accountant.

ORDER NO. 29874

32" & 36" TRIPLE GEARED LATHE
BED WORKS
FOR LATHE WITH SEPARATE CHANGE GEARS

SAMPLE No.	SCREWS		WANTED	SAMPLE No.	PINS		WANTED	SAMPLE No.	NUTS		WANTED
84	5/8"	P. 4737	3	270	1/4"	P. 8929	2	8	1"	F. 4684	1
232	3/4"	P. 18401 6		276	3/8"	P. 9008	2				
249	3/4"	P. 18401 7	5	330	1/4"	Rack * *					
287	3/8"	Rack * *		420	1/4"	P. 8386 *					
656	1"	P. 18401	6	422	5/16"	SA. 2, Oil Cover	1				
4	5/32"	Index Plate	2	377	1/4"		7				
				378	3/16"		3				
				384	3/16"		2				
									KEYS		
									* 27 Key	F. 4684	1
									3/16 x 3/16 x 1 Key	P. 10348	1
				P. 11697 Index Plate			1				
				* Oil Cover			1		CRANK WRENCHES		
								5	1/2" Sq. Straight Wrench		1
								14	1/2" Sq. Straight Wrench		1
									J.H. WILLIAMS & CO.		
								* 811	Hexagon Box Wrench, for 1 1/4" St'd Nut		1
									DROP FORGED WRENCHES		
								9	3/4" U.S. Standard *		
								8	3/4" U.S. Standard * *		
	* 4 for each Leg				* 2 for each Pair of Trips			-	* 1 for Ls. with Taper Att.		
*	* Issue on Foreman's Order			8	* 2 for each Piece of Rack			*	* 1 for Ls. with Forming Att.		

STOCK SUPPIES ORDER NO. 12.23-04

The Engineering Magazine

FORM A 9. DRAWING-ROOM REQUISITION.

Blue print, 10 by 12 in. The printed text on this reproduction of course appears as draughtsman's lettering on the original. Sent to rough-stores keeper, copied by him into his "shop orders" book, and sent to the stores accountant by whom it is used in filling Form 9, upon which the items are separated into related groups.

to forgings or bars, instead of castings. Forms A9 are made in the drawing room, together with a sufficient number of separate sheets of the same size (blue prints) specifying castings and forgings components for the same production-order number. Forms A9 are sent

STORES RECORD OF _____

PRICE { Date _____ / F.O.B. { Par _____ / Discount } }

Net Cost { Date _____ / At _____ / Par _____ }

Add Freight and Cartage

ORDERED							RECEIVED				USED AND ON HAND							
REQUISITION			FOR SHOP ORDER OR ACCOUNT	ORDER		FROM WHOM	INVOICE				Date	ON SHOP ORDER NO. OR ACCOUNT	Quantity in _____		Date	ON SHOP ORDER NO. OR ACCOUNT	Quantity in _____	
DATE OR NO	QUANT. IN _____	PIECE NO. or Remarks.		NO.	Date		Date	QUANT. IN _____	NO. OF _____ or REMARKS				Used	on Hand			Used	on Hand
																FROM 1ST. COLUMN		
						Forward to { Other side / Sheet No. _____ }						To { Next Column }				To { Other side / Sheet No. _____ }			

The Engineering Magazine

FORM 9. STORES RECORD OF STORES DISBURSED TO INDIVIDUAL PRODUCTION ORDERS.

Filled by the rough-stores-keeper's accountant from Forms A9, related components for the same order being kept on the same sheet so far as possible. Finally bound in Tengwall binders. The right-hand column gives the component inventory at the date of insertion of the last sheet.

DRAWING OFFICE
OF
THE POND MACHINE TOOL CO.

Plainfield, N. J., ... 190

Order No. .....

Stock Room deliver to Machine Shop the material required by specifications attached. When stock is delivered record on specifications the weight and number of pieces. Send to the Factory Accountant a daily record of stock delivered for this order.

Filled .....

In Charge

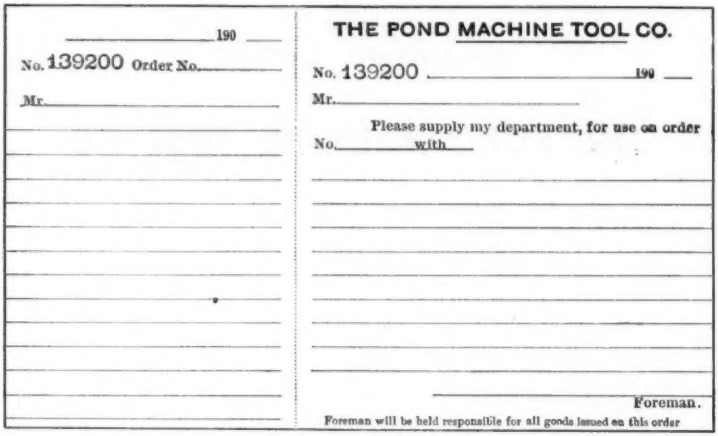
Form No. 4.

FORM B 9. PRODUCTION-ORDER COMPONENT-CHARGE INSTRUCTIONS FROM DRAWING-ROOM TO STORES KEEPER.

Filled by drawing room, sent to stores keeper, by him satisfied and sent to factory accountant. Green paper, 8 in. wide by 5½ in. high.

to the rough-stores keeper, and the specific titles are copied into the "shop-orders" bound book, by him; this book is simply his sequence memorandum of production-order numbers, for his reference only, with no values recorded.

Forms A9 are given by the rough-stores keeper to the stores accountant, who fills Forms 9 from Forms A9, separating the items into related groups on Forms 9, which are afterward made into sepa-



_____ 190 ____

No. 139200 Order No._____

Mr._____

THE POND MACHINE TOOL CO.

No. 139200 _____ 190 ____

Mr._____

Please supply my department, for use on order No._____ with ____

_____

Foreman.

Foreman will be held responsible for all goods issued on this order

FORM 10. "THE RED ORDER."

Numbered consecutively, and bound in stub books of 500 each, 5¾ by 10 in. over all, the order being 6 and the stub 4 in. wide. Filled by any foreman and satisfied by rough-stores keeper.

rate volumes in Tengwall binders, each component having a bin-inventory column at extreme right, verified by actual semi-yearly count and survey.

Forms A9 are next given to the stores-keeper's delivery clerk, who satisfies them with deliveries from stores to the construction foreman having the production order in hand.

Form A9 has Form B9 pinned to it when sent from the drawing room to the stores room.

For minor orders Form B9 is used alone, without Forms A9, or 9, is satisfied by the stores keeper, and sent to factory accountant. Larger orders or orders requiring more detailed information, are pinned to Forms A9, and the two are sent, fastened together, to the stores keeper.

Form 10 is known in the Pond shops as the "red order"; it is filled by any foreman and is either satisfied on presentation to the rough-stores keeper by immediate delivery of the requisition, or at his option is sent to the Head for his approving signature. If the requisition is not in stores, Form 1 is filled to procure the satisfaction. Form 10 is made to bridge all the gaps in the Pond factory requisition procedure, and is used for replacements of components missing after supposed delivery to a construction foreman, for incidental forgings, and by the tool-room foreman for all forgings or

castings or other material needed to fill a general small construction order from the drawing room, issued and vitalized by the chief draftsman, as for example:—"The following work to be done and returns made to factory accountant of time on same;

12 Counterbores, Sa. 334.

(Signed) Geo. E. Greenleaf.

Send to Mr. Newman."

Mr. Newman, foreman of the tool room, would fill a Form 10 blank and present it to the rough-stores keeper to obtain material—or, in case the tool-room foreman desired a new machine tool, the same Form 10 would be filled and transmitted to the rough-stores keeper; in this case the Form 10 would go to the Head for his vivifying signature.

The Pond tool room is divided into two departments, located in a single enclosure, but having two heads, of equal rank, the foreman of the tool-room, and the foreman of the tool-makers. The foreman of the tool-room keeps up the supply of all cutting tools produced by forging, tempering, and grinding only, and also keeps up the supplies of files, emery, emery paper and cloth, and repairs on taps, dies, and arbors. Where machine work is required the foreman of the tool-room notifies the foreman of tool-makers, by word of mouth or by a written communication, and the foreman of the tool-makers then fills Forms 10 to satisfy. In case of lathe and planer forged tools, the foreman of the tool-room fills Forms 10 for tool steel needed, which forms are satisfied by the rough-stores keeper, the tool-steel bars being delivered to a private locked tool-steel store and the key held by the tool-room foreman, who issues forging orders on "yellow" forms, not shown here, and presents them with needed tool-steel bars to the tool-smith.

File replenishments are made by requisitions on Forms 10, sent to the rough-stores keeper. Taps, dies and reamers, new, are bought from outside suppliers, the repairs only being made in the tool room, Requisitions for replacement are made on Forms 10.

Form 11 completes the list of form blanks used by the rough-stores keeper. As will be noted, the rough-stores business is transacted in long-hand, some entries being twice written. The system in use has grown up from next to no system at the beginning, forms which seemed to meet imperative requirements being added from time to time. Cards are not used at all, and there is no check on the tool-steel-bars keeper. Medium and large iron and steel bars are racked outside the shop. The rough-stores keeper's office is en-

closed, is small, and is crowded. The rough-stores racks and bins are all unenclosed, standing open to access by workmen from the main floor. The bins are on two floors, are poorly lighted, and have electric bulbs between the banks of bins. Originally each bin had a "sample" of its contents fastened outside; this is not now invariably the case, numbers being used, but the word "sample" is still retained in the Pond rough stores phraseology. The rough-stores room is about 600 feet from the drawing room, and from the factory accountant's and finished-stores keepers' desks. The drawing room, finished-stores keeper, factory accountant, and rough-stores keeper communicate often, leading to many miles of travel on foot daily.

No. 11700 _____ 19 *Received from* _____	No. 11700 _____ 19 *Received from* _____

The Engineering Magazine

FORM II. ROUGH-STORES-KEEPER'S DRAYMAN'S RECEIPT.

Stub book, 3½ by 8 in., consecutively numbered; thin yellow paper. Used for draymen's deliveries to rough stores only.

The Pond Finished Stores.—These are kept on about 200 feet of the machine-shop floor, at the easterly end, unseparated from the machine shop, and are in charge of a finished-stores keeper (who is also the shipping clerk) and one helper. The Pond finished stores are received wholly from the machine shop, and are composed of completed machines and components of production orders in progress. The finished stores have no separate books and no placement list is made. The parts are large, and though pieces may remain in store for years, all parts belonging to one order number are placed as close together as may be, and no inconvenience results. Stout shelving is racked in several rows across the easterly end, and there are some iron cross-arm racks next the shelving, for long slender pieces, screws, rods, and the like. Then comes a long floor

DRAWING OFFICE
OF
THE POND MACHINE TOOL CO.

Order No._____ Plainfield, N. J., _____ 190__

Storekeeper: Furnish **Machine Shop** _____ *parts below.*

for _____

PARTS REQUIRED ARE MARKED X	ORDER	ORDER
Uprights,		
Crossrail with saddles,		
Arch,		
Arch works,		
Top works,		
Running works,		
Feed works,		
Driving works,		
Driving shaft,		
Feed shaft,		
Table,		
Front side saddle works,		
Front side saddle feed works,		
Back side saddle works,		
Back side saddle feed works,		
side saddle click boxes,		
end leg castings,		
middle leg castings,		
Main counter,		
Elevating counter,		
ft. in. of table rack,		
pairs of track oilers,		
Slotting attachment,		
Slotting attachment counter,		
Screw cutting attachment,		
Joint in bed,		
Motor and necessary parts,		
Box for sea shipment,		
Wanted,		
Completed,		

FORM I, FINISHED STORES. DISBURSEMENT TO FACTORY CONSTRUCTOR.

Filled by the drawing office, and sent for satisfaction to finished-stores keeper. 7½ in. wide by 11 in. high, white paper. Vertical column rules under the words "order," with a narrow column to the left for the × mark, have been omitted by the engraver.

DRAWING OFFICE
OF
THE POND MACHINE TOOL CO.

Plainfield N.J. _____ 190 Order No. _____

Storekeeper, Furnish _____ the following

Wanted, _____

Delivered, _____

The Engineering Magazine

FORM 2, FINISHED STORES. REGULAR PRODUCTION SHIPMENT ORDER, USED ALSO FOR REPAIRS OR REPLACEMENTS FROM FINISHED STORES.

Brown paper, 5¼ by 8½ in., blocked in pads with white interleaves for carbon copy. Filled in type-writer by the drawing room; original sent to finished-stores keeper and duplicate retained and filed. When satisfied, the order is so marked and dated by the stores keeper and returned to the drawing room.

space of piled components, completed machines and large components standing separately on the floors. The finished stores are covered by the main and side traveling cranes. The boxing is at the westerly end, south of the rough-stores room.

The finished-stores keeper has a desk in the factory-accountant's office, nearly midway of the machine shop, and across the shop from the drawing room.

Finished-stores disbursements are made by the finished-stores keeper to satisfy requisitions made by the drawing-room superintendent only. The finished-stores keeper keeps no books, and keeps and fills four form blanks only.

Form 1, is (1) a finished-stores requisition by the drawing room, filled by the drawing room, sent to the finished-stores keeper, and satisfied by delivery of the specified components to a factory constructor; (2) Form 1 is used as the factory production order, same order number as (1), with specifications added as required.

The "wanted" and "completed" are date lines, are superfluous, and are not filled.

Forms 1, when satisfied, are attached by the finished-stores

keeper to the production order, same number, and sent with it to the drawing room.

Form 2 is the regular production shipment order, also used for repairs or replacements from finished stores. It is satisfied by delivery of the specified articles to the shipping clerk, marked delivered, with delivery date, attached to order, and returned with order to the drawing room.

Form 3, finished stores, is filled in manuscript in the drawing room and sent to the finished-stores keeper. It is used where substitutions of production details are made, to return superseded parts to finished stores. It is satisfied by the signature of the finished-stores keeper, and sent to the drawing room.

Of course, though not in this story, all orders and attached documents go from the drawing room to the factory accountant.

This is the one and only form blank used by the finished-stores keeper solely. It is the "waiting" stores receipt, filled and signed

STORE CREDIT ORDER.

No. 2100 Mr._____ _____ 190

Finished parts returned on Order No._____ Machine_____

Please credit same Made on Order No._____

	NO.	MAT.	LBS.	AMOUNT		WORK HRS.		AMOUNT	

Received by Storekeeper_____

The Engineering Magazine

FORM 3, FINISHED STORES. USED FOR SUBSTITUTION OF DETAILS IN PRODUCTION ORDERS.

Filled in manuscript in the drawing room, sent to the finished-stores keeper, satisfied by his signature, and returned to drawing room. Gray paper, 7¼ by 8¾ in.

STORE RECEIPT. No. 6602

Received 190 on order

The Engineering Magazine

FORM 4, FINISHED STORES. "WAITING" STORES RECEIPT.

Numbered consecutively in a stub book; thin yellow paper, 4 by 5½ in. Filled and signed by stores keeper on receipt of finished components waiting assembly or shipment. Pinned to production order and sent to the drawing office on completion of the order.

by the finished-stores keeper on receipt of finished components (commonly from a factory constructor, possibly from rough-stores keeper) which components are to be held by finished-stores keeper until required for assembling in the completed machine or for shipment to a purchaser. The finished-stores keeper is also the shipping clerk. Forms 4 are pinned to the production order and both are sent to the drawing office on completion of order.

The most difficult problem of the long shop is the locating of the offices and the points of entrance for materials and exit for finished product so as to give the shortest lines of official communication and travel, with the fewest handlings and shortest transportations of work in progress. If all the officials are grouped at about the middle of the works, in offices just above the cranes, with rough stores on one side of the principal entrance and exit, and finished stores and the shipping room on its other side, and the drawing room above the offices, with the blue-print and photographic department yet above the drawing room, a good architectural effect is gained by the elevated structure in the middle of the long shed; the drawing room is up out of the dust, the blue-print and photographing rooms are well lighted, and the officials can be placed close to each other and their fields of duty. If supplies come and product goes chiefly by rail or

water, it becomes imperative that the materials entrance be crosswise of the shop, and it is also very convenient to have a driveway across the middle of the main floor, under the offices, and a cross-wise corridor on the office floor above the driveway, so as to give straight through travel from the street to the heavy transportation way.

While it is perhaps both desirable and possible to confine official communication mainly to writing, many occasions demand oral communication and face to face interviews between officials, and even with the best arrangements of central telephone office in the reception room added to a constantly traveling messenger service, factory officials often find need for talking personally to each other.

The shortest lines of rough-stores and work-in-progress transportation are had by the midway rough stores and finished stores and shipping room, and all these considerations seem to point to the desirability of the elevated offices located at the middle of the long shop, though this is not the usual arrangement. The factory plan is yet a matter for debate—the cross, the hollow-square, the L and E forms all finding advocates, while a 1904 construction places four factory buildings, one 800-feet long and three each 500-feet long, east and west length, parallel to each other about 100-feet apart, on a flat plot with no rail or water communication established, so that the constructor was free to choose his factory plan.

In the Pond shops the main office and drawing room and finished-stores-keeper's desk are not far apart. The rough-stores keeper and purchase agent is 600 feet away, and the boxing and shipping is 800 feet from finished stores. This arrangement makes long lines of travel for both rough and finished stores and the keepers thereof, who act respectively as purchase agent and shipping clerk in addition to having charge of the stores.

The photographic illustrations were taken during and immediately after a heavy snow-storn, and do not give a favorable impression of out-of-doors racking of bars.

Both rough and finished stores seemed to be well kept, though the rough-stores-keeper's office had not room enough for the storage of the large volumes which must accumulate under the record system employed.

THE SUPERHEATING OF STEAM, AND ITS INFLUENCE ON ENGINE ECONOMY.

By R. Neilson.

I. MODES OF SUPERHEATING, AND TYPICAL FORMS OF CONSTRUCTION.

Mr. Neilson's paper is the first of three dealing comprehensively with the most interesting factors in the economy of the modern steam engine—superheat and vacuum. The current part discusses the various modes of superheating and types of superheaters; the second takes up the effect of superheat on engine efficiency; the third covers the subject of vacuum—forms and operation of condensers and their influence on the economy of the power plant.—THE EDITORS.

SUPERHEATING steam—that is raising its temperature above the boiling point corresponding to its pressure—is by no means a new thing. It was proposed by Joseph Hately in 1768*; and there are several instances of steam being superheated for the purpose of economy prior to 1835. There are, however, difficulties in connection with the production of superheated steam and difficulties in connection with its use in reciprocating engines; and these difficulties, although they were at no time insuperable, have no doubt been the cause of superheated steam not being extensively used until the last few years.

In the production of superheated steam there has been the difficulty of preventing the superheating tubes (for tubes have almost always been used for this purpose) from being at times seriously overheated, and there has been the difficulty of getting from the superheater a constant supply of steam at even approximately uniform temperature. In the use of superheated steam with reciprocating engines there has been the difficulty of lubricating the working parts exposed to the steam, and the difficulty of preventing a fracture in the cylinder or connected parts owing to difference of expansion.

If the demand for steam varies greatly and varies rapidly, and especially of the changes in demand are unforeseen, then, whatever be the method of heating the superheating tubes, there will be great difficulty in always obtaining the same temperature in the steam leaving the superheater, unless some automatic device be used whereby the rate of supply of heat to the steam can be made to vary with the rate of discharge of the steam from the boiler to the engine or

* Specification of Patent No. 895 of 1768.

engines (by way of the superheater). If a reservoir or receiver could be provided for the steam between the superheater and the engine or engines, so that the flow of steam through the superheater would not vary so greatly as the rate of consumption of steam by the engine or engines, the temperature of the superheated steam could (without any automatic device) be more readily kept approximately constant. The cost of such a reservoir would however be great, and heat radiation losses from it would also be great. The idea therefore seems hardly practicable.

It is of course desirable in almost all cases that the steam should leave the superheater at a constant temperature. This temperature is that which is judged in any particular case to be the best for economy, considering all things. If the temperature of the steam falls below this, the engine, as a rule, will fall off in efficiency; if the temperature rises above this, the engine may be exposed to risk of damage. It is true that some steam engines will stand a very high temperature of steam without any risks being incurred; but, even with these engines, there is bound to be a best temperature, or range of temperature, at which to work, although what this best temperature is may not always be known.

In considering superheating from the point of view of economy to the steam-engine user, it is of course necessary to take into account the depreciation of the superheating plant and the effect of the use of superheated steam on the depreciation of the steam engine, whether that engine be of ordinary construction or specially constructed for use with superheated steam. The risk of accidents which will totally disable the superheating plant or the engine for a long or short period must also be taken into account, not only as regards cost of repairs but as regards possible losses due to stoppage or shortage of power.

The difficulties and dangers connected with the production and use of superheated steam vary greatly with the method adopted for heating the superheater tubes. We may conveniently divide the methods into four classes, as follows:—

Method 1.—Heating by a furnace, independent of the boiler furnace.

Method 2.—Heating by the hot gases (products of combustion, etc.,) passing from the boiler furnace to the chimney.

Method 3.—Heating by the hot gases before these have ceased to act on the boiler.

Method 4.—Heating by a fluid which is itself heated by the hot

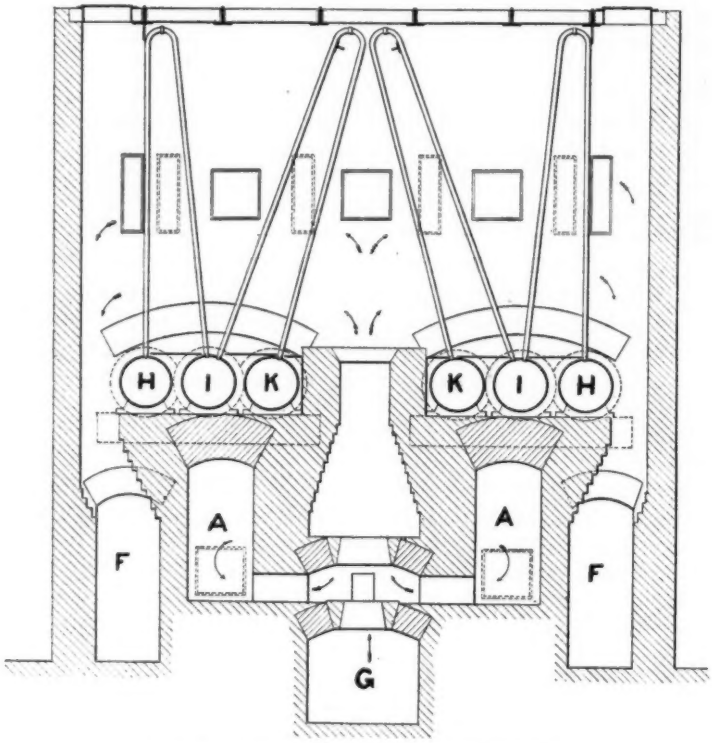


FIG. I. WATKINSON'S GAS-FIRED SUPERHEATER.

Built by Mechan & Sons, Glasgow, for Colville & Sons' steel works at Motherwell. Capable of dealing with 260,000 lb. of steam per hour. Steam pipes leading to and from the superheater are each 2 ft. diameter.

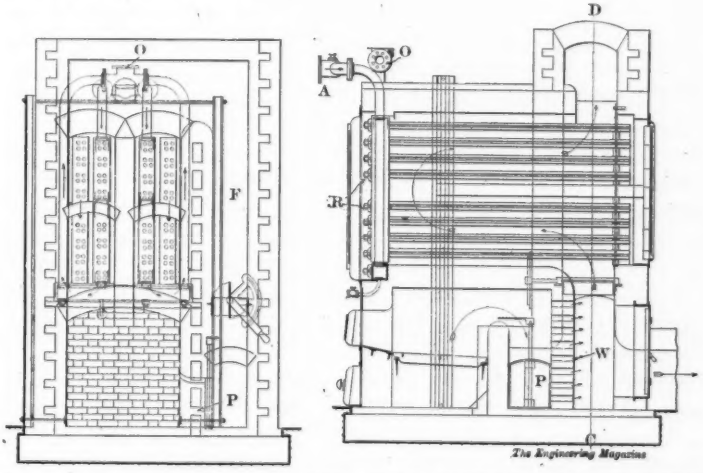
gases to a higher temperature than the required temperature of the superheated steam.

These methods will now be considered one by one. It should be explained that no attempt is made in this article to describe all the important forms of superheaters; my object is only to exemplify the various methods of superheating.

Method 1. Employing a Furnace Independent of the Boiler Furnace.—By this method the superheater is quite distinct from the boiler and the firing of the boiler does not in any way affect the superheater. An example of this method is given in Figure 1, which shows a Watkinson superheater quite distinct from any boiler

and fired with producer gas. The gas enters the superheating chamber from the flues A as shown in the arrows, and is met by air from the gas main G. The products of combustion come into intimate contact with the tubes of the superheater and then leave by the flues F. The steam is arranged to flow in counter-current fashion to the hot gases. The steam is admitted to the outside drums H H and passes through the outer sets of inverted U tubes to the intermediate drum I, and then through the inner sets of U tubes to the drums K from which it is led away to the engine. Prof. Watkinson informs me that since the installation of these superheaters, the rolling-mill engines have been found to run much more rapidly than with saturated steam. Plates which previously took 4½ minutes to roll now take 2½ minutes. This quickness in rolling is of course a very important matter.

In the Watkinson superheater the tubes in each bank are spaced very closely together, with the idea of causing the hot gases to pass through very narrow spaces and thus to deprive them of a great amount of heat at each bank.



FIGS. 2 AND 3. CROSS SECTION ON LINE C D AND SECTIONAL ELEVATION, BABCOCK AND WILCOX INDEPENDENTLY FIRED SUPERHEATER.

This method of superheating allows of the superheater giving a very uniform supply of heat. As, moreover, the supply of gas and air can be turned on only after there is a sufficient flow of steam through the superheating tubes and the heat supplied to the tubes

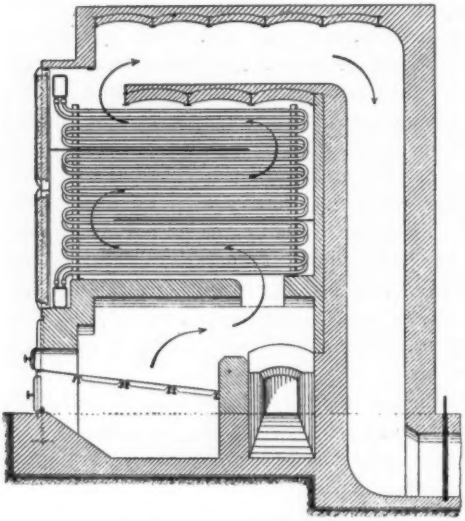


FIG. 4. INDEPENDENTLY FIRED SUPERHEATER, CONSTRUCTED BY THE RHEINISCHE DAMPFKESSEL UND MASCHINENFABRIK BÜTTNER, VERDINGEN A. R.

can to a great extent be regulated with comparative ease, it should not be difficult in most cases to prevent injurious overheating of the tubes and to prevent serious irregularity of the temperature of the steam leaving them, even with great variations in the supply of steam. It is only in a few cases, however, that a supply of producer gas is available. When such a supply is not available, a special furnace must be provided for the superheater. A superheater fired by its own independent coal furnace is illustrated in Figures 2 and 3, which show a construction adopted by Messrs. Babcock & Wilcox. The products of combustion from the grate pass over the bridge B and through the perforated wall W. This wall acts as an accumulator or reservoir of heat. The hot gases then pass upwards among the tubes as shown and down through the side flue F to the chimney. The steam enters at A and is divided into two portions, one passing into each half of the superheater. After passing through the tubes, which are of U shape, the steam is led to the outlet O. It will be seen that the tubes are arranged in sets of four. Caps are provided, one for each four tube ends, these caps being held in place by the small bridges R. A safety valve is placed on the inlet pipe. A by-pass P is provided so that when desired the gases can be shunted direct to the flue F.

Another example of an independently fired superheater is given in Figure 4, which shows a superheater constructed by the Rheinische Dampfkessel und Maschinenfabrik Büttner. In this superheater tubes of considerable length are employed, these being bent into zig-zag fashion as shown and arranged each in a vertical plane.

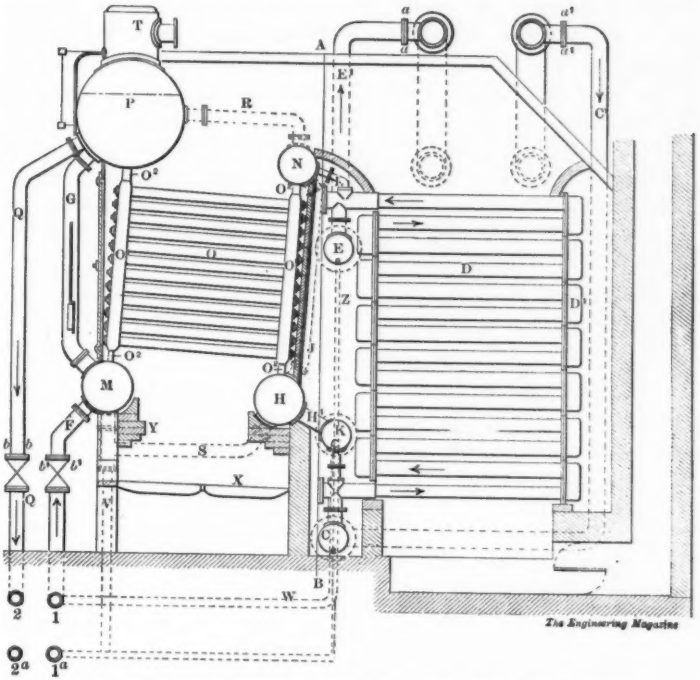


FIG. 5. CRUSE SUPERHEATER COMBINED WITH FEED-WATER HEATER.

A B, vertical section; C, bottom saturated-steam collector; C¹, steam pipes to C; D, steel superheater tubes; E, top superheated-steam collector; E¹, steam pipes from E; F, feed-water supply from main; G, downcomer pipes to bottom drum, M; H, bottom drum (back); H¹, connecting pipes from H to K; J, downcomer pipes from N to H; K, bottom water collector; L, controlling water connecting pipes; M, bottom drum (front); N, top water collector; O, water-heater—4-inch steel tubes, 6½-inch pitch; O¹, headers for O, 6 inches square, 6½ inches pitch; O², connections to drums; P, top drum; Q, hot-water outlet to feed boiler; R, top connection between P and N; S, circulating connections; T, steam drum; V, blow-off and mud tap; W, cold feed for regulating temperature of superheat; X, furnace bars; Y, arch; Z, drain pipes.

By uncoupling any tube from the upper and lower headers, the tube can be removed through the front doors.

When an independent furnace is employed to fire the superheater precautions must be taken to prevent the superheated tubes nearest the fire being seriously overheated. The Cruse Controllable Superheater Company of Salford combine a feed-water heater with a superheater and cause the hot gases to act first on the water tubes so that, when the gases reach the first tubes containing steam, they are at a temperature not above 1,400 degrees F.

Figure 5 shows a construction of superheater designed by this company. O indicates the feed-water tubes which extend nearly horizontally between two headers, the whole feed-water part of the construction being arranged somewhat after the nature of a Babcock & Wilcox marine boiler. The hot gases, after ascending through between the feed-water tubes, pass downwards between the superheating tubes D through which steam passes in counter-current fashion. This combined feed-water heater and superheater is intended to supply hot water to a battery of boilers and to superheat the steam from the same. F is the feed-water supply from the main, and Q is the hot-water outlet to the boilers, C is the saturated-steam collector and E is the superheated-steam collector. The special feature of the Cruse superheater will be referred to later on.

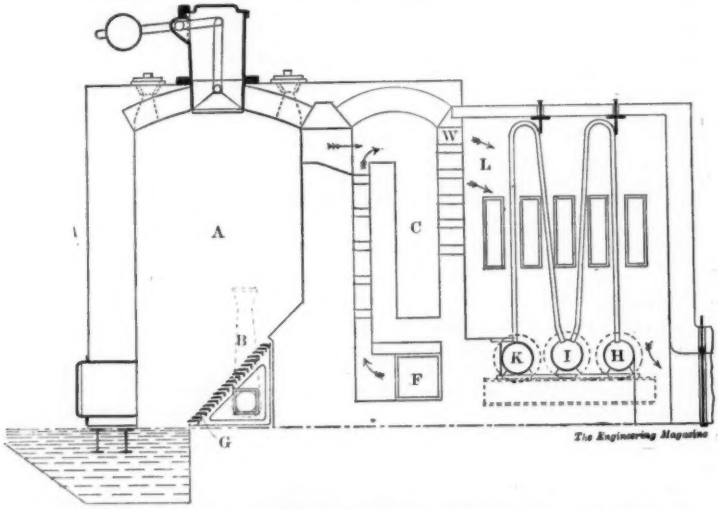


FIG. 6. WATKINSON GAS-FIRED SUPERHEATER PROVIDED WITH ITS OWN GAS PRODUCER.

When an independent furnace is employed to fire the superheater, this, instead of being of the ordinary kind, such as that just described, may be of the producer type. An example of this is given in Figure 6 which shows a Watkinson superheater provided with its own gas producer. A is the producer in which the producer gas is formed, air being drawn through the grate G and steam forced through the blower B. The producer gases pass out of the top of the producer to the chamber C, where they meet with air which enters

through the duct F and passes upwards through the brickwork as shown by the arrows. A secondary combustion takes place in the chamber C, and the products of combustion then pass through the perforated wall W to the chamber L in which are situated the superheater tubes. H, I, and K are respectively the inlet, intermediate, and outlet steam drums. The temperature of the superheated steam can be adjusted by varying the rate of supply of steam to the blower.

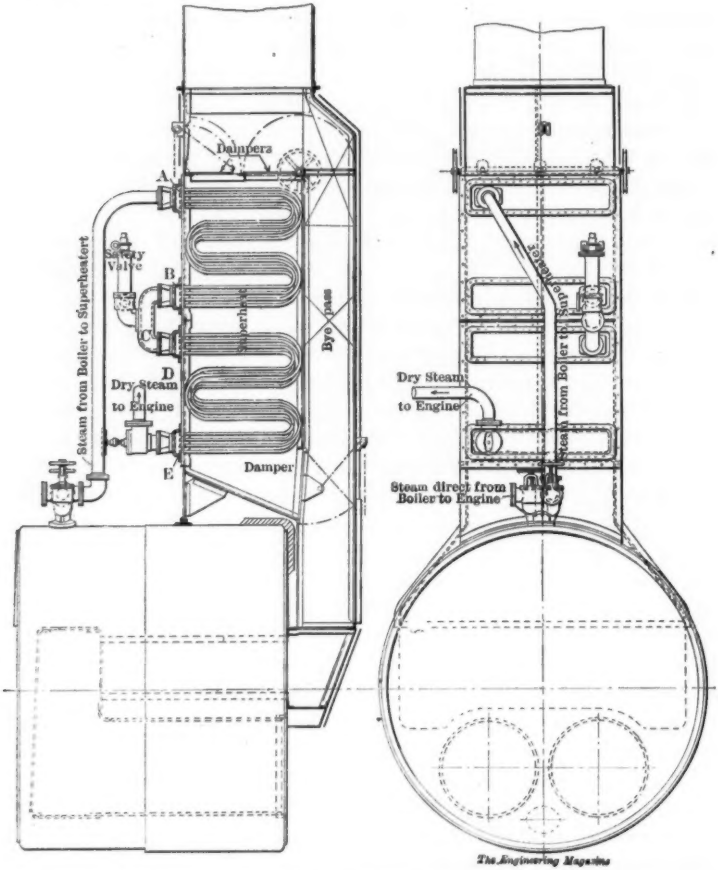
Superheaters provided with furnaces of the producer type have the advantage over those provided with ordinary furnaces that with a uniform flow of steam through them, they require less attention, and with a variable flow of steam the temperature of the steam is more easily controlled. It will be obvious that, with a furnace as shown in Figure 6, the amount of heat given to the superheater can be varied much more quickly than with an ordinary furnace.

A separately fired superheater has many advantages. It can be used in conjunction with any boiler or set of boilers without disturbing others, and is independent of the temperature at which the waste gases leave the boiler or boilers. In a well designed stationary boiler with natural draught, the waste gases should pass up the chimney with only sufficient heat to give the necessary draught, and the chimney should be designed so as to allow of this waste-gas temperature being as low as is reasonably possible. With a stationary boiler designed for forced or induced draught the temperature of the gases passing up the chimney should by the design of the boiler be brought still lower—though often the opposite is the case. With such boilers the waste gases cannot be used for firing superheating tubes, as no heat can be spared. A separately fixed superheater is in most cases to be preferred for such boilers.,

Another advantage possessed by the independently fired superheater is that it can be stopped and started without affecting the efficiency of the boiler or boilers with which it is used in conjunction. Another advantage is that the independent-superheater fire need not be started till steam is passing, or just about to pass, through the superheater tubes on its way to the engine, thus preventing these tubes being burnt out through being subjected to a fierce heat without any cooling agent flowing through them in the interval while the water in the boiler is being raised to boiling point.

Method 2. Heating the Superheater by the Hot Gases on their Way from the Boiler to the Chimney.—This method ought to be subdivided into two classes, which may be very different from each other.

A.—all the hot gases leave the boiler at approximately the same temperature (at any instant) and pass to the superheater and then to the chimney.



FIGS. 7 AND 8. SUPERHEATER MADE BY THE CENTRAL MARINE ENGINE WORKS, WEST HARTLEPOOL.

B.—The hot gases are divided in the boiler flue or flues. Part are shunted off to the superheater, from which they pass to the chimney, while the other part are given a further course through the boiler and then pass direct from the boiler to the chimney.

An example of Class A is shown in Figures 7 and 8, which il-

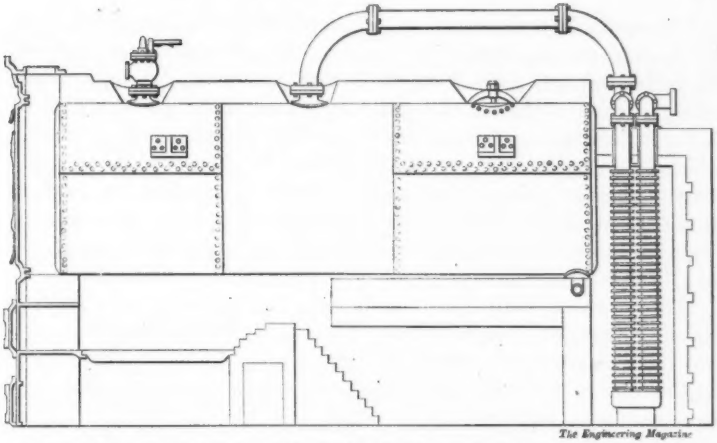


FIG. 9. FOSTER STEAM SUPERHEATER, APPLIED TO HORIZONTAL RETURN TUBULAR BOILER.

Power Specialty Co., New York.

lustrate a design of superheater being made at The Central Marine Engine Works, West Hartlepool. The superheater is shown fitted to a two-furnace return-fire-tube marine boiler. The superheating tubes are each made, as will be seen, with four straight lengths and three curved connections, and are arranged in two sets in series in the front uptake of the boiler. A by-pass is provided to allow the hot gases to pass direct to the chimney without passing over the superheating tubes, and dampers are provided as shown to control the flow of the gases. The steam from the boiler is led as shown to the pocket A, whence it enters the top ends of the top set of superheating tubes, down which it passes to the pocket B. It is then lead by the pipe C to the pocket D, which communicates with the top end of the second set of superheating tubes. The steam passes down these tubes to the pocket E, which is connected by way of a stop valve with the steam pipe leading to the engine. It will be seen that the superheater is arranged in counter-current fashion, which should be a decided advantage in a superheater of this nature, if the temperature of the gases is fairly low, as it probably will be.

An example of class B is shown in Figure 10, page 953, as used in a single-screw vessel having two boilers of the usual fire-tube marine type. The index accompanying the drawing indicates the principal parts. The heating surface consists of two sets of wavy vertical tubes and the steam passes up through one set of tubes

and down through the other set. The portion of the hot gases used for heating the superheater is led from the combustion chamber of the boiler through tubes F to the casing containing the superheater tubes, whence the funnel 11 in each case leads away the waste gases to the main funnel. A small fan is provided which suplies an air jet which by an injector action draws sufficient of the hot gases through the superheater casing. This air jet is used to regulate the amount of superheat of the steam. The remainder of the hot gases passes from the combustion chamber through the fire tubes to the front uptake in the usual manner.

This method (both cases) of heating the superheater tubes has the disadvantage compared with Method 1 (independently fired) that the temperature to which the tubes are subjected is apt to vary considerably. It is therefore difficult to obtain a constant temperature for the superheated steam. This is especially the case when, owing to a varying demand for steam, the consumption of fuel per hour is not constant. It is true that when the boiler is working at high power, the steam flows at a higher velocity through the superheating tubes than it does when the boiler is working at a lower rate, and the steam therefore remains a shorter time in the tubes, and has less time to take up heat, and this serves to compensate to a certain extent for the difference of temperature of the hot gases impinging on the tubes. It would be difficult, however, to arrange for anything like a perfect compensation, even if the stoking were always the same for a given delivery of steam from the boiler. This constant relation between the stoking and the delivery of steam cannot however be counted upon with a fluctuating load—the boiler must act to a certain extent as a reservoir of energy. The difficulty of giving the steam a uniform superheat is therefore increased. With this method of heating the superheater, we must deal with the problem also of preventing the superheater tubes being seriously overheated in the period while steam is being raised and before any is passing out of the boiler. This is sometimes prevented by flooding the tubes with water during this period. This method is objectionable however, and a better method which is sometimes adopted when the tubes cannot stand the heat is to by-pass the hot gases during this period, as shown in Figures 7 and 8.

Before leaving this method of superheating it seems right to mention that some water-tube boilers are arranged in such a manner that some of the tubes or parts of tubes contain only steam. These tubes or parts of tubes are exposed to the heating action of the gases

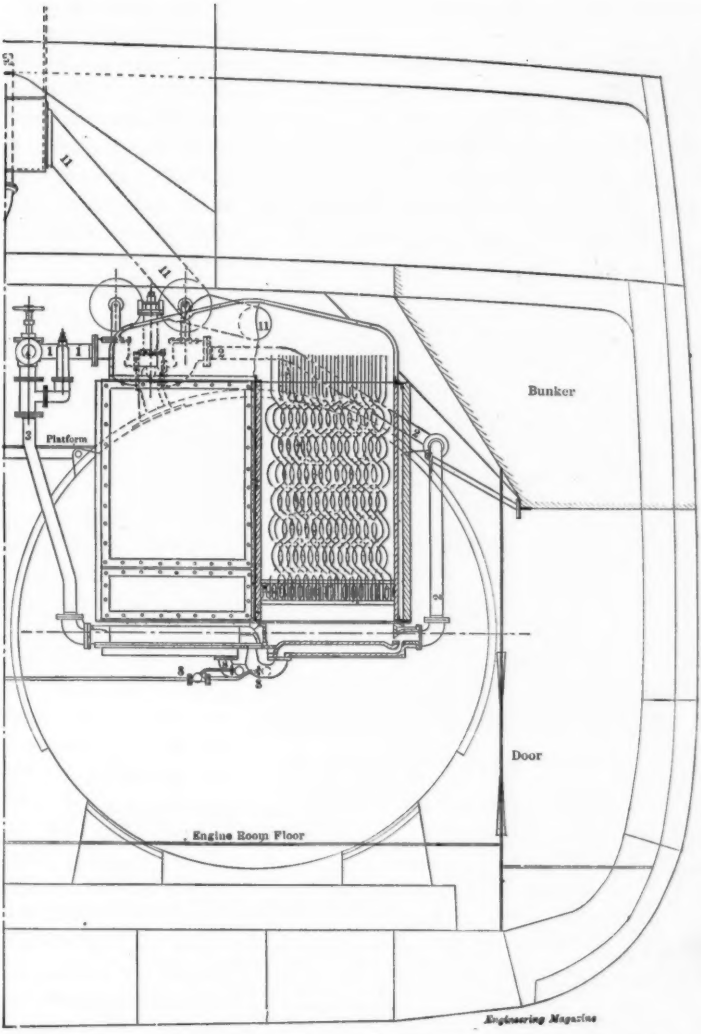


FIG. 10. ARRANGEMENT OF "CENTRAL" SUPERHEATER IN A STEAMSHIP.

Index of pipes. 1, steam direct from boilers to engine; 2, steam from boilers to superheaters; 3, steam outlet from superheaters; 4, main steam pipes; 8, drain pipes from superheaters; 11, superheater funnels. Central Marine Engine Works, West Hartlepool.

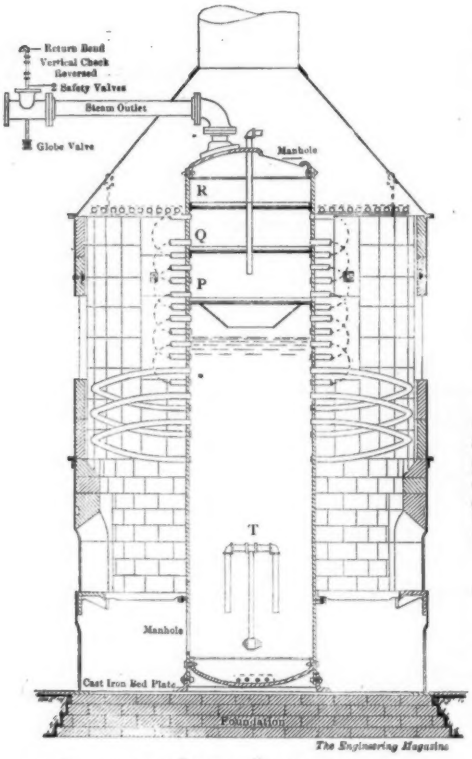


FIG. 11. MORRIN "CLIMAX" WATER-TUBE BOILER. Built by the Clonbrock Steam Boiler Works, Brooklyn, and B. R. Rowland & Co., Ltd., Reddish, England.

rising from the furnace and the steam is superheated. There is really in such cases a combined boiler and superheater. A good example of such a boiler is the Morrin "Climax" boiler.

One of these boilers having an evaporative capacity of 2,500 to 3,000 pounds per hour is shown in Figure 11. The boiler consists of a vertical cylindrical drum which is about two-thirds filled with water, the other one-third being filled with steam. Several furnaces are provided around the drum at its lower end, and above the furnaces and extending nearly to the top of the drum are a large number of small-bore curved tubes. The ends of these tubes are expanded into the drum, one end being higher than the other. Most of the tubes contain water only, but it will be seen that some have one end above the water level, while a considerable number have both ends opening into the steam space. P is a conical baffle plate which is used to prevent or at least to reduce the amount of water which is thrown into the steam space in the boiler. R is a perforated diaphragm and Q is a diaphragm which is unperforated except for two small holes to allow any water, carried over in the curved tubes, to drain back to the water portion of the drum. The products of combustion pass upwards from the furnaces and come into contact first with the water tubes and then with the superheater tubes. Lastly the hot gases come in contact with a feed-water coil,

through which the feed water is passed before being admitted to the drum by way of the pipe T.

Method 3. Heating by the Furnace Gases Before They Have Ceased to Act on the Boiler.—This method is exemplified by the superheaters shown in Figures 12 to 19.

Figure 12 shows a superheater constructed and fitted to a Lancashire boiler by Messrs Galloways, Ltd., of Manchester. The hot gases impinge on the superheater tubes after leaving the internal boiler flues and before passing along the bottom flue (to return by

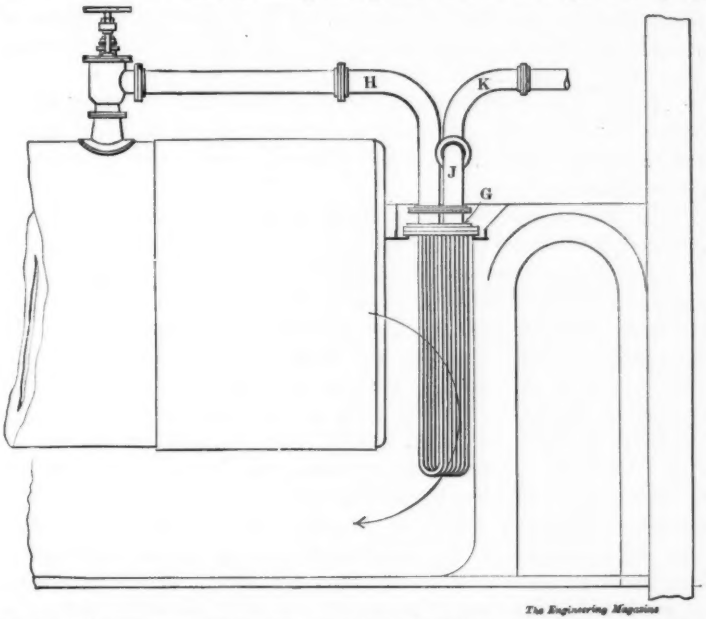


FIG. 12. GALLOWAYS SUPERHEATER FIXED IN DOWNTAKE OF LANCASHIRE BOILER.

the side flues to the chimney). The superheater tubes are of U form and their ends are fixed in a tube plate forming the lower side of a flat two-chambered box. This box is shown at G in Figure 12. It receives steam into one chamber by the pipe H, and the steam after passing through the U tubes (which are all in parallel) enters the other chamber of the box which it leaves by two pipes J which unite in the pipe K. Messrs. Galloways construct the entire superheater of Siemens-Martin mild steel.

Figures 13 and 14 show a design of superheater constructed by

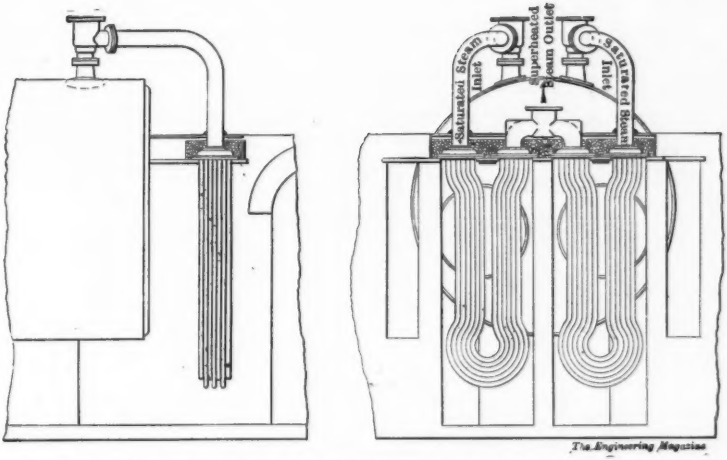
Messrs Tinkers, Ltd., of Hyde, near Manchester. The plates are constructed of Siemens-Martin mild steel and the tubes are weldless and of mild steel. With this class of superheater dampers are often provided so that when desired the hot gases can be by-passed clear of the superheating tubes.

A damper is provided in the construction shown in Figure 15, which illustrates a double boiler fitted with a superheater constructed by A. Hering of Nürnberg. The gases, leaving the internal flue in the lower shell, pass according to the position of the sliding damper either through the superheater chamber as shown in the figure or direct to the chamber behind the upper shell. They then pass through tubes in the upper shell.

Messrs. Easton & Anderson employ Field tubes in their superheater for use in the downtake at the back of a Lancashire boiler, and the Cruse Controllable Superheater Company have a design on the same lines.

The Babcock & Wilcox combination of superheater and water-tube boiler is shown in Figures 16 and 17. Two T tubes, L, L, are arranged in the steam-and-water drum. The heads of these T tubes are situated well above the water level and the tubes convey the saturated steam through the bottom of the shell to the box M of the superheater. From this box the steam flows through the superheater tubes to the box N, and the superheated steam leaves this box by the pipes P, P, which unite at the coupling piece Q. The superheating tubes are all in parallel and are arranged in sets of four. They are solid-drawn steel tubes and before being bent are of about the same length as the boiler tubes but of much less diameter. They are expanded into the boxes M and N in sets of four and an inspection cap is provided on each box for each set of four tubes to allow of the tubes being examined. The curved ends of the tubes which cannot so readily be examined are protected by the baffle R. Instead of conveying the saturated steam to the box M in the manner illustrated, Messrs. Babcock & Wilcox usually now employ outside pipes for this purpose, the steam leaving the boiler drum at the top in the usual manner.

Figure 18 shows a somewhat similar superheater constructed and fitted to a boiler by Messrs Walther & Co., of Kalk bei Köln am Rhein. The arrangement of baffles among the water tubes of the boiler puts this superheater more in the direct path of the gases from the furnace to the chimney, but at a later position in the path than is the case in the Babcock & Wilcox arrangement. For this reason



FIGS. 13 AND 14. SUPERHEATER FOR LANCASHIRE BOILER, INSTALLED IN DOWNTAKE FLUE AT BACK END.

Constructed by Messrs. Tinkers, Ltd., Hyde, near Manchester, England.

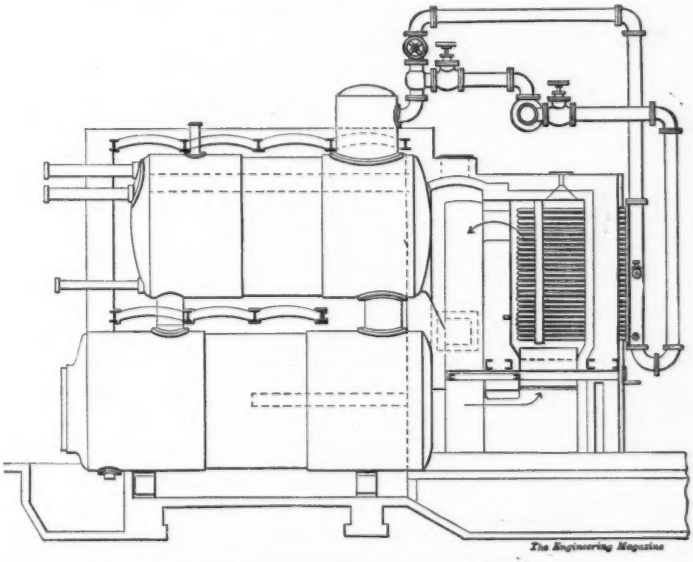
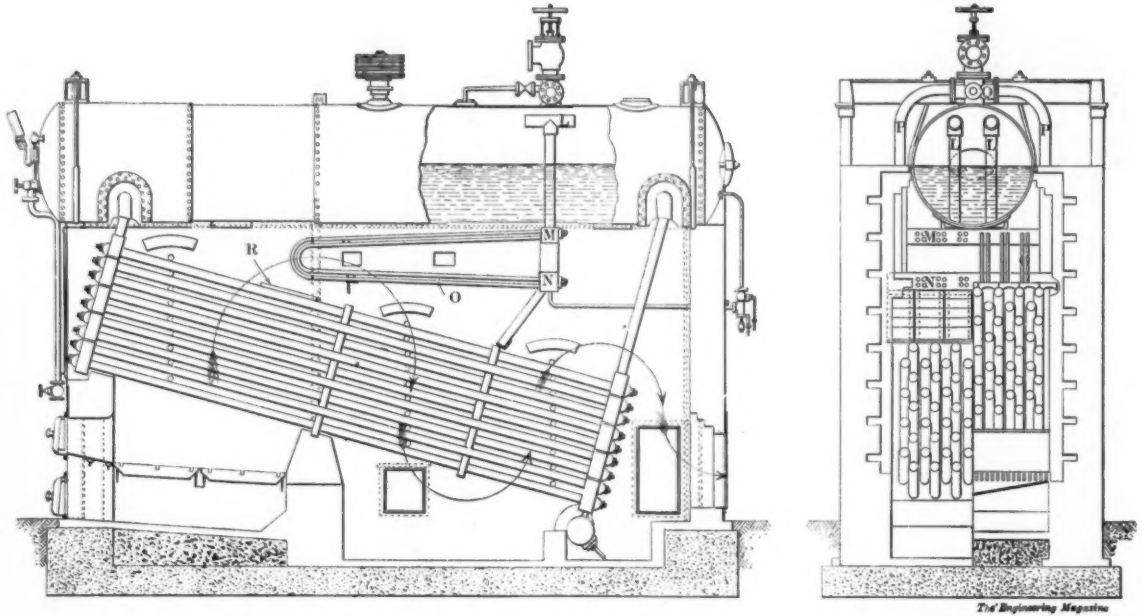


FIG. 15. HERING SUPERHEATER FITTED TO A DOUBLE BOILER.



FIGS. 16 AND 17. LONGITUDINAL AND TRANSVERSE SECTIONAL ELEVATION, BABCOCK & WILCOX BOILER AND SUPERHEATER.

the Babcock and Wilcox arrangement appears to me to be rather the better of the two as regards the variation of temperature to which the superheater will be exposed.

This method of heating the superheater tubes sometimes approaches very close to Class B of Method 2, as sometimes, owing to the position of the superheater tubes, some of the waste gases can get past without coming into intimate connection with the tubes.

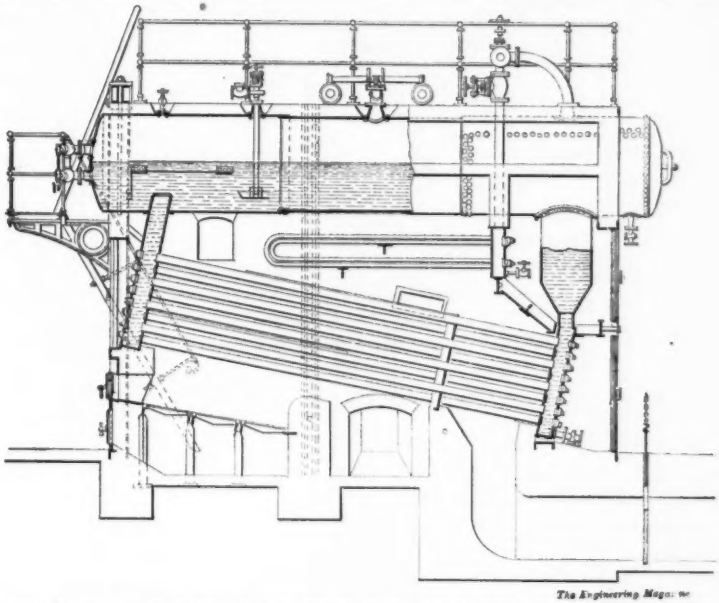


FIG. 18. WATER-TUBE BOILER AND SUPERHEATER, WALTHER & CO., KALK BEI KÖLN AM RHEIN.

This method has much the same defects as Method 2. The superheating tubes are exposed to a fiercer heat than in Class A of Method 2, and therefore the danger of their being overheated is increased; but this method has the advantage that it can be applied to boilers from which the waste gases leave at too low a temperature for Method 2 to be employed. Method 3 allows of a smaller heating surface in the superheater than in either class of Method 2.

A method of superheating intermediate between Methods 2 and 3 is illustrated in Figure 19, next page, which shows a couple of three-furnace single-ended marine boilers fitted with superheaters. The hot gases act on the superheater only after they have finally quitted

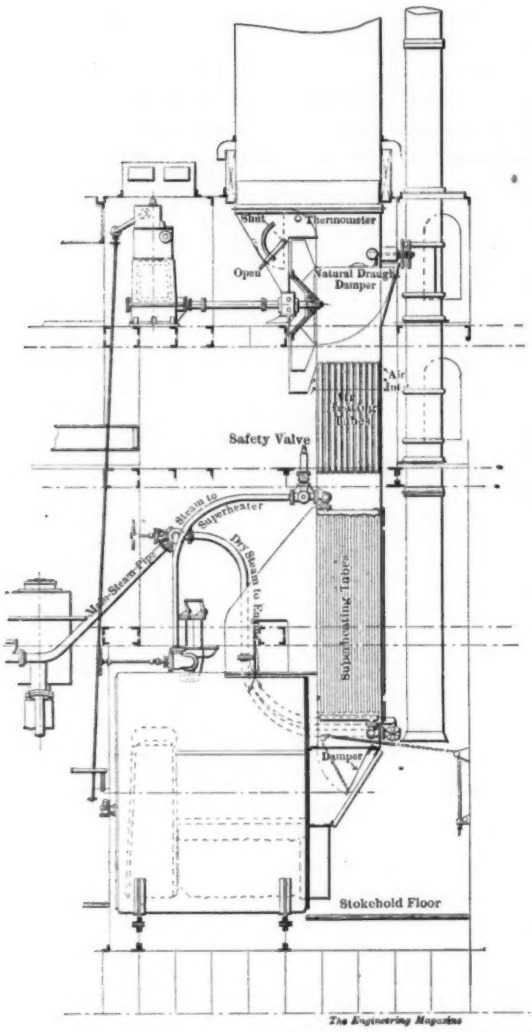


FIG. 19. ARRANGEMENT OF INDUCED DRAFT AND "CENTRAL" SUPERHEATERS ON THE STEAMERS INCHDUNE AND INCHMARLO.

Marine boilers and superheaters built by the Central Marine Engine Works, West Hartlepool, England.

the boilers; but, after acting on the superheaters, the hot gases are employed to heat air passing to the boiler furnaces. The drawing shows the design of boilers and superheaters supplied by The Central Marine Engine Works to the steamers Inchdune and Inchmarlo of Messrs. Hamilton, Fraser & Co. of Liverpool. The superheater for each boiler consists of three sets of vertical wavy tubes situated in the front uptake. Each set conveys steam from a top header to a bottom header, the steam thus passing in counter-current fashion in the opposite direction to the hot gases, which, after leaving the superheater, continue their upward journey through a set of

tubes (shown in Figure 19) which are used for heating the air passing to the furnaces. The air is drawn through between these tubes, through these furnaces, through the fire tubes in the boiler, and along the uptake, by fans (one for each boiler) according to the Ellis & Eaves system of induced draught.

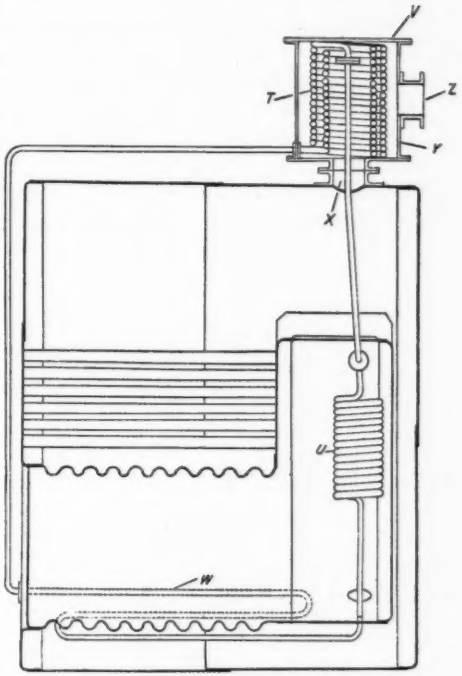


FIG. 20. PROF. WATKINSON'S PROPOSED DEVICE FOR SUPERHEATING BY MEANS OF AN AUXILIARY FLUE.

The figures in the table below were obtained in a test on board the steamer Inchmarlo on October 26th, 1900. The working pressure of the boilers was 267 pounds and the engines supplied by these boilers were of the five-cylinder, quadruple-expansion type. The high-pressure cylinder was lined but not steam-jacketed. The first intermediate cylinder, the second intermediate, and the two low-pressure cylinders were all steam jacketed.

	Temperature in degrees F.
On deck	53
In stokehold	77½
Air entering furnaces	299
Hot gases below superheater	587
Hot gases above superheater	543
Hot gases above air-heating tubes	404
Steam at inlet to superheater pipes	412
Steam after passing through superheater	469½
Steam at high-pressure steam chest	447

Method IV. Employing a Fluid which Is Itself Heated by the Furnace Gases and which Imparts Heat to the Steam.—This method has been proposed by Prof. Watkinson, who suggests the construction shown in Figure 20. A fluid having a high boiling point is contained in a tube U, placed in the combustion chamber of a boiler

and formed into a coil to give sufficient heating surface. This coil is connected to a double superheating coil T placed within a casing at the top of the boiler, and this in turn is connected to a pipe W which is arranged with three laps in the (usually) still water at the bottom of the boiler. The pipe W is connected to the coil U, thus forming a closed circuit. The fluid with the high boiling point can flow along this circuit but never mingles with the water or with the steam. The steam passes at X from the boiler to the superheater casing V, and leaves this casing at Z. By this method of superheat-

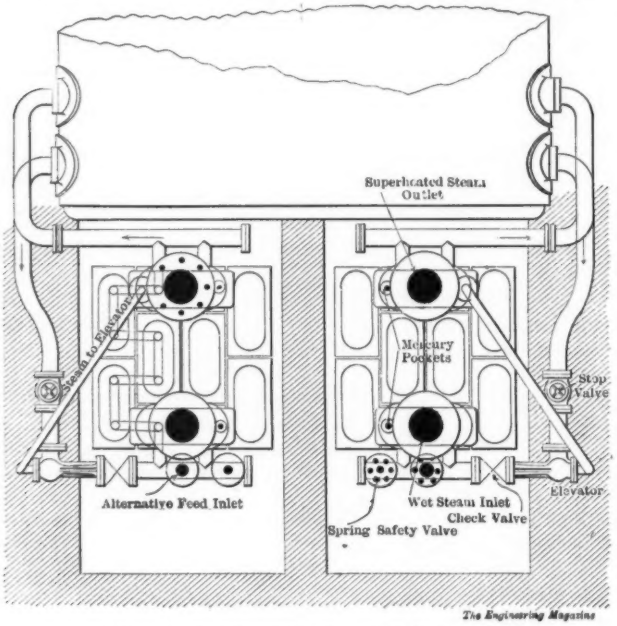


FIG. 21. CRUSE SUPERHEATER. HORIZONTAL SECTION.

ing, there can be no danger of tubes containing superheated steam being subjected to an excessive temperature. A relief valve can be arranged to prevent the pressure (and therefore the temperature) of the auxiliary fluid exceeding a certain amount. The lengths of pipe W are also useful in improving the circulation of the water in the boiler, especially during steam raising.

Some of the advantages of such an arrangement are obtained in the Cruse controllable superheater without the employment of an auxiliary fluid.

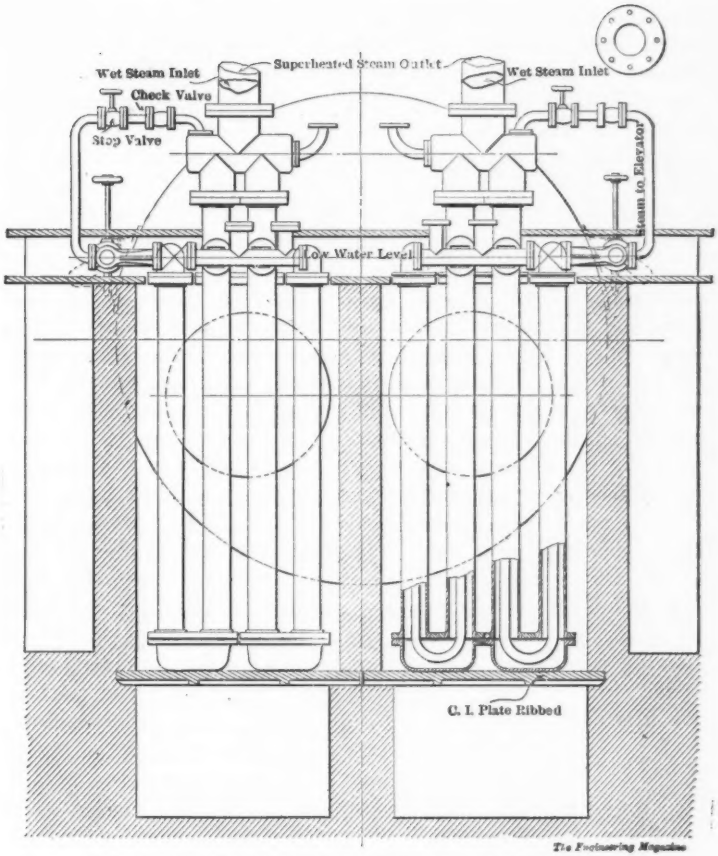


FIG. 22. CRUSE SUPERHEATER FITTED TO LANCASHIRE BOILER.
Cruse Controllable Superheater Co., Salford.

In the Cruse superheater the steam passes through tubes of fairly large diameter—6 inches is a common size, but tubes as large as 9 inches in diameter have been used. The tubes are built up and arranged in sets of 16, 24, 32 or other convenient number.

Figures 21 and 22 show a 32-tube Cruse superheater applied to a Lancashire boiler. It will be seen that a chamber of considerable size is placed behind the boiler. The tubes are arranged in four sets of eight each and rest on a cast-iron ribbed plate. In each set of eight tubes, the steam passes alternately up and down the tubes,

that is to say, the eight tubes are in series. The superheating tubes are of steel, hot-rolled and weldless. The copper water pipes in each set of eight tubes are connected together in series. The circulation of water in the inner pipes prevents the steam in the superheater tubes from getting overheated and the provision of an annular passage instead of a circular passage for the steam tends to break it up and get it uniformly heated. It will be obvious on a little consideration that heat radiated from the inside surface of a superheating tube is in the ordinary case received by the opposite walls of the tube. In the case of the Cruse tube, however, a large part of the heat radiated from the inner walls of the tubes passes to the water tubes and is absorbed by them. It is not at all necessary for the water tube to touch the outer tube in order to relieve it of a large amount of heat. The amount of heat conducted by the steam from the outer to the inner tubes will probably be comparatively small, but the amount of heat radiated from the outer tubes to the inner tubes and not returned must be very large when there is a considerable difference of temperature betwen outer and inner tubes.

It is not an uncommon practice to superheat only part of the steam generated by a boiler or battery of boilers and to mix this steam with saturated steam (sometimes fairly wet) with the object of preventing or lessening the risk of the steam passing to the engine or engines at an excessively high temperature. This method of working will not of course prevent fluctuations in the temperature of the steam passing to the engine, but the maximum temperature which is likely to occur will be less than it would otherwise be.

An ingenious device for controlling the temperature of superheated steam passing to an engine is the invention of Mr. J. E. L. Ogden of Liscard, Cheshire. This device provides for superheated steam and saturated steam being mixed together in certain proportions before passing to the engine, the proportions being controlled thermostatically according to the temperature of the superheated steam passing to the engine. This device has the advantage that, if the heat to which the superheated steam is subjected should fall off, the saturated steam can be completely and automatically cut off and the low-temperature superheated steam from the superheater alone used; while if the superheater be subjected to an excessive temperature, only a very little of the superheated steam will be allowed to mix with the saturated steam and pass along the main steam pipe to the engine.

A DISCUSSION OF SYSTEMS OF POWER SUPPLY FOR MINE OPERATION.

By F. V. Henshaw.

Mr. Henshaw's article is especially interesting as an extension of the discussion suggested by the contributions of Dr. Porter and Professor Roberton in our special Labor-Saving Number of January last.—THE EDITORS.

POWER supply for mining operations is of prime importance, affecting as it does the output, cost of production, and even the life of workmen in one of the greatest industries. As compared with the power requirements of a city or factory, those for a mine are similar, with these additions:—The power must be transmitted through tunnels and rooms in proximity to workmen. There must be nothing to vitiate the surrounding air. The power and transmission appliances must be able to withstand moisture and explosive and sulphurous gases. They must meet special hoisting conditions in deep mines. The power must be well adapted to rock drilling. The system that has been found best for cities and factories should therefore be best for mines, if it can be made to meet these additional requirements in a satisfactory manner.

In the generating plant, where few of these conditions begin to apply, the general requirements are of course extremely close to those of the general power plant, but the situation of the mine or the character of its allied workings may impose special limitations or offer particular opportunities.

The steam engine, dating it from Watt's first patent, is one hundred and thirty-five years old, and with the utmost refinement in large powers has attained a thermal efficiency of 22 per cent.; an extreme economy under ideal conditions would be 1 pound of coal per indicated horse-power hour, for the whole steam plant. No such efficiency can be obtained in practice, and 1.5 pounds of coal per indicated horse-power hour, is about the best that can be expected under the most favorable conditions. The efficiency of steam turbines is about the same as that of the most economical piston engines, for the same kind of service.

The steam turbine has a considerable advantage over all piston engines in space and cost when used for driving dynamos, as the latter can be made much smaller and cheaper on account of the high

speed. This high speed is well suited to alternating-current dynamos, but generally objectionable for direct-current machines of the usual commutating type. The "unipolar" type of direct-current dynamo is now being developed for direct connection to turbines and is very promising. The economy due to concentrating the power generation for a mine or several mines at one point is obvious. An interesting case of evolution in this direction is the Hampton plant, near Scranton, Pa., where a central boiler plant for five collieries was built a short time ago, power being transmitted by means of five steam mains up to a distance of 3,140 feet.

The gas engine is about forty-four years old, has attained a thermal efficiency of 26 per cent. in small sizes, and with modern gas producers can develop an economy of 1 pound coal per indicated-horse-power hour, under conditions of practice. Gas engines as large as 1,500 horse-power were built five years ago, and their practical operation has been thoroughly tested in Europe. One might consider that the gas engine practically begins where the steam engine stops, as far as fuel economy is concerned.*

For all mines having coke ovens, or blast furnaces within a reasonable distance, gas engines are the natural sources of power. Attention has been drawn of late to the vast power wasted in the making of coke and iron. It is not within the province of this article to take up this subject at length, but the following figures may be cited as indicating the magnitude of a source of power, now largely wasted, which will surely be put to profitable use in the future:—

Mr. C. G. Atwater states† that in the United States 95 per cent. of the coke was made without recovery of the by-products in 1901, and in England 80 per cent. was made in the same manner in 1898. Mr. A. M. Gow calculates‡ that a blast furnace producing 15 tons of iron per hour develops enough gas to furnish 9,000 horse power over and above the power required for the furnace blowing engines.

Objections have been made to the gas engine, on account of its relative size and consequent high cost, lack of starting power and overload capacity, and the necessity that has been found for cleaning of its interior parts, resulting in a shut-down for several hours at regular intervals. Considering the power plant as a whole, it will be seen that against the size and cost of the gas engine itself, there are offset the condensers, economizers, mechanical stokers, and compli-

* See Dr. Mond's remarks on paper by H. A. Humphrey on Power Gas and Gas Engines, Inst. M. E., Dec., 1900.

† Transactions Am. Inst. Mining Engineers, Oct., 1902.

‡ Transactions Engineers Soc. Western Penn., April, 1903.

cated steam and water-piping system, with pumps, heaters, etc., all of which are required in an economical steam plant, but which are either done away with entirely, or greatly simplified in a gas plant. The gas producer is simpler and cheaper than an equivalent high-pressure boiler. Gas permits an efficient storage of power, and has a considerable advantage over steam in this respect. With liberal gas holders there is always a reserve of power immediately available.

The lack of starting power and overload capacity are certainly disadvantages, but the first is not very serious in power stations where engines do not start under load, and the second simply means a liberal size of engine. The trouble from fouling of valves has been largely overcome and it can reasonably be expected that it will be eliminated as a serious factor.

Considering now the matter of the distribution of power, we note that central power plants for cities and factories have been in operation for many years, using high-pressure water, compressed air, and electricity. Rope transmission and steam may be omitted from the present discussion. Gas has been used almost exclusively for lighting and heating, and while the possibilities of distribution of power by gas are considerable it is highly objectionable in mines.

Of the three successful methods, electricity has so far exceeded the others in the extent and magnitude of its use that it can hardly be said to have a rival in the general field. The distribution of hydraulic power has been in use in nine cities in England for many years, but compared with electric plants these undertakings are insignificant. These hydraulic plants would doubtless have done better had the impulse wheel been developed earlier and thus given them a simple and efficient motor. The exhaust water is an objection that puts the hydraulic system out of consideration for distribution, except possibly in some surface workings.

Where high natural heads are available hydraulic transmission may be utilized to bring power to the mine, there to be converted into electric or compressed-air power for distribution. Local conditions do not always lend themselves favorably to the construction of a pipe line, while there are practically no limits in the case of electric power lines. This is a plain engineering question, which must of course be decided for each case according to the local conditions, taking as the basic factors relative first cost, together with the advantages of a concentrated power plant at the point of distribution, *versus* a distant power station transmitting to a sub-station.

Compressed air demands particular consideration in the present discussion, as not only does it come into the class of successful

methods of power distribution, but it is peculiarly well adapted to mine work, and has, in fact, been developed chiefly for that purpose, and for civil-engineering works of the same general nature. Compressed air developed by steam power has been distributed for general power purposes, over an area of several miles, in the city of Paris for some seventeen years, a sufficient demonstration of its engineering and commercial success. It is, however, hardly necessary to cite further instances to demonstrate the importance of compressed air for power transmission, and the discussion resolves itself into a consideration of the merits and limitations of compressed air and electricity. Considering these two agencies from the point of comparative advantages in transmission, and taking Prof. Unwin's* figures for air power, there is little to choose between air and electricity on the score of efficiency, though the loss from leakage, in practice, would probably be much greater with the former. But high-pressure air mains are less flexible, and probably more expensive in most cases, than electric power mains. Certainly compressed air could not be considered for transmission, unless it is also used for general distribution. For coal and iron fields, having power-gas by-products available, it might be found best to locate a central plant at a distance from the source of gas, conveying the gas by a pipe line.

The distribution of power, however, is largely the key of the whole problem. The reasons that have given electricity almost the entire field of general power distribution might be considered sufficient to establish its universal use in mines. Such, however, is not the case, and the best practice today may be found in the combination of air and electricity. Evidently electricity is not considered as meeting all the special requirements of mine work. The reasons are not far to seek, and the question to be considered is—can electricity be made to do equally well the work for which air is now used?

Just as the voltage of great electric-power stations has been fixed by the possibilities of one device—the incandescent lamp—so in another way the air-power system owes its existence in mines to the percussion drill. Electric power is not well adapted to develop reciprocating motion for rough work. The simple and rugged construction possible in a piston drill, and above all the elastic steam or air cushion, gives these agents great advantage over electricity. A number of electric percussion drills have been and are made, using either solenoids to develop reciprocating motion or converting rotary motion of motors to reciprocating by mechanical means. One form of the latter type might be considered electro-pneumatic, the drill piston be-

* The Transmission and Distribution of Power from Central Stations by Compressed Air.

ing actuated by compressed air delivered by what may be called the motor-driven piston.

The advantage of permitting the adoption of a single agent for all power distribution, and its high efficiency, are in favor of the electric drill; but in simplicity, strength to withstand rough usage, and general reliability, the air drill still holds its own. It is doubtful if the electric drill can be made to compete with the air drill strictly on its own merits, but at the same time it hardly seems to have received all the attention it deserves. From the nature of electric power, one would look for improvements in the direction of rotary drills.

With the exception of the rock drill, there is little argument in favor of air versus electricity in mines. There are no problems in haulage to which the electric motor is not well adapted. The control of motors for very large winding machines is somewhat simpler with air than electricity, but the latter power gives a more uniform torque, equal or greater nicety of adjustment, and higher plant efficiency. For cable haulage up slopes, and for traction work, electric motors are well suited. The air locomotive has a limited mileage and requires a supply system at 500-pounds to 1,000-pounds pressure, which is costly, not altogether safe, and is too high for drills, hence making a double air-supply system necessary. The air locomotive is also more bulky and generally requires more head room than the electric locomotive. The electric "gathering" locomotive enables cars to be hauled from the working faces about as well by electric as by air power. At the Ehrenfield, Pa., coal mines there is a novel system of traction whereby grades of some 10 per cent. to 12 per cent. are negotiated by electric locomotives by means of a third rail in which are holes engaging the teeth of sprockets on the locomotive. The third rail is insulated and also acts as a conductor. On levels or light grades the locomotive is worked from an overhead trolley in the ordinary way.

Air power is advocated as better than electricity in that it assists ventilation in mines. Ventilation by high-pressure air is not good engineering, and the power wasted in the air drills would make things better for the miner if expended in motor-driven fans drawing air from main headings or ventilation shafts. Electric mains are better adapted to running through shafts, crooked tunnels, etc., than any other power conveyor. There is but one requirement—they must be insulated. Without going into details, it can be confidently stated that there are no difficulties in insulating conductors in mines that cannot be overcome by intelligent engineering using ordinary materials. Outside of specialists in electricity few persons realize how little insulation a system may have and still keep going. This,

together with the extreme flexibility and adaptability of electric wires and motors, has resulted in much construction work the equivalent of which would not be tolerated in any other branch of engineering. As a natural result, troubles due to insulation failures have been exaggerated.

The danger from electric sparks in gaseous mines cannot be eliminated, though it can be greatly reduced by care in the electric installation. The alternating-current induction motor without contact rings cannot produce sparks except it be damaged, and controlling switches can be made to break circuit under oil. There is always liability to spark ignition with electric traction. Careless handling of lights and explosives is a far greater menace than a well designed and carefully inspected electric system. In workings in which open lights and explosives are prohibited, and which cannot be sufficiently ventilated, compressed air should be used for greatest safety.

In respect to danger from shock, it may be said that this also has been exaggerated, it being human nature to fear the mysterious. When a man is killed by a falling roof, dynamite explosion, or even by foul gas from a "flaming" air compressor, the cause of death is understood. To be knocked over by simply touching a wire is uncanny and impresses the imagination. Up to 300 volts the danger from shock is nil, while above 500 volts it begins to be serious. It also happens that 500 volts is about the maximum for satisfactory direct-current motors, which are the type best suited to traction work. The data as to the electric pressure that will kill are very inexact, but judging from the few fatal accidents in proportion to the vast number of persons handling 500-volt power in street railway and other industries the risk from that pressure cannot be great. From my personal experience and observation of many shocked persons, I would say that 500 volts cannot kill a normal man unless he is connected in circuit so that he cannot break loose. Such a condition is very rare and happens as a rule only to electrical workmen.

While an exact statement as to the element of danger from shock due to the introduction of 500-volt pressure into mines cannot be made, it can be fairly said that this element does not add materially to the risks of mining. It is indeed a question whether the elimination of animal power and underground stables by substituting 500-volt traction would not, on the whole, increase the miner's expectation of life. To anyone familiar with the work now done in mines and steel works by electric power the question of power distribution in the former is confined to the kind of electrical machinery and methods to be adopted.

COST KEEPING ON GENERAL CONTRACT WORK.

By A. W. Buel.

The purpose of this article is to bring to the attention of contractors engaged in building railroads, bridges, buildings, and public works the importance and value of accurate cost keeping and to induce them to contribute directly or indirectly to the current literature on the subject, on the principle that an exhange of ideas injures no one and benefits all. This is no more than a continuation and special application of the series of articles on *"Cost Keeping"* that have occupied a prominent place in THE ENGINEERING MAGAZINE for several years. Not often has a subject been presented by any periodical devoted to one group of industries that has received so much attention continuously for a long period, and few if any similar series have resulted in so much material benefit to industrial progress.

It may be that a considerable number of general contractors are now using up-to-date cost-keeping systems, and for the general success of this line of business it is to be hoped that such is the case; but diligent inquiries by the editors of THE ENGINEERING MAGAZINE have failed to elicit from more than 10 per cent. of those approached anything than can be called a system or method. If the other 90 per cent. are using modern methods, they are hiding their light under a bushel. The author and the editors will be well compensated for their initial difficulties and disappointments if this beginning leads to the encouragement of other contributions and the formation of a new body of cost-keeping literature in the field of general contract and construction work.—THE EDITORS.

THE remarkable growth of manufacturing industries during the past fifteen years, particularly in stability and competitive strength, has been contemporaneous with the development and introduction of systematic methods of cost keeping. It is not too much to say that one of the most important elements contributing to this growth has been the increasing efficiency of the system employed for auditing accounts. Without question much is due to improvements in the other departments of our industries, but the suggestions to which these improvements are due, as well as the final judgment which has retained and passed them beyond the experimental stage, has often been based on the records of an accurate system of cost keeping.

A good system of cost keeping must be accurate, quick, and in ample detail. It should be adapted to the business and complete enough to give the cost of each element of the work separately, without being so cumbersome as to break itself down or become burdensome to the organization. The expense of a modern system need not be materially greater than that of an antiquated, crude, and inefficient way of keeping accounts. Above all, it must be such as to give the detailed costs of each part of the work while the business is fresh, and not weeks or months afterwards.

What systematic cost keeping in detail has done for manufacturing industries it can do for general contractors, and often in greater measure. It is generally admitted that the business of a general contractor is one of the most difficult industrial enterprises to manage successfully. As a general rule the organization is not entirely permanent, but changes to some extent with each new contract. The location of the work is first in one place and then in another, and whatever of permanency the organization possesses must be accompanied by the characteristics of mobility which introduce complications. Not only do most of the conditions of the work vary for each contract, but the kind and class of work may be entirely different. These and other difficulties that confront the manager of large and diversified contract works are sufficient to demand not only a good cost-keeping system, but the best that can be devised, one that will be to him both eyes and ears.

Elaborate cost-keeping systems, as well as mechanical inventions, have been devised to meet necessities. Their introduction in manufacturing industries has been brought about by the narrow margin of profits due to competition, the magnitude of the enterprises, and the complications of the operations. The question naturally airses, do the same causes exist on contract work?

Margins of estimated profits are fixed not only by competition but by the risk or unknown elements in the cost. In some lines of manufacturing, the risk, under normal conditions, is so small that a 5-per-cent. profit is acceptable in dull seasons, and at times of industrial depression many products are sold at cost. Under similar conditions the minimum *estimated* profit accepted by contractors varies from 10 or 15 per cent. up to 25 per cent. or over for subaqueous or other hazardous work, and a smaller margin is likely to have disastrous financial results. Briefly stated, the risks or unknown elements of cost range from about 10 per cent. upward, and just so much of a contractor's *estimated* profits are a pure speculation. The remainder of the *estimated* profit, after deducting the speculative risk, is the average or true profit, and the margin of the latter in contract work is not so much greater than in competitive manufacturing enterprises as is generally supposed.

The real average margin is small enough to demand rigid economy, and this can be maintained on extensive works only by promptly ascertaining the cost in detail. Anything that reduces to a minimum the unknown elements of cost and brings them under more perfect control, makes for financial stability, and this is the office of all cost-keeping systems.

That the magnitude of contract works as compared with manufacturing enterprises is sufficiently great to warrant the adoption of approved methods needs no argument, and the same is true of the relative complications involved in the operations. If any one should doubt this statement, it will suffice to mention the Geo. A. Fuller Co., with twenty or thirty skyscrapers under construction at one time and in several different cities, the New York and Boston Subway contracts, and many railroad-construction contracts ranging over a million dollars each. Much of this work is really more complicated than many lines of manufacturing, and a close analysis of the operations will often disclose many elements in that which at first seems quite simple.

A study of the question will show that the necessity for good cost-keeping systems on contract works is in most cases as great as in many manufacturing establishments where they have been introduced. The necessity existing, have contractors generally adopted modern systems, and if not why not? The replies to 90 per cent. of the requests for information as to how costs were kept and distributed are fairly illustrated by the following quotations,—some inquiries remaining unanswered.

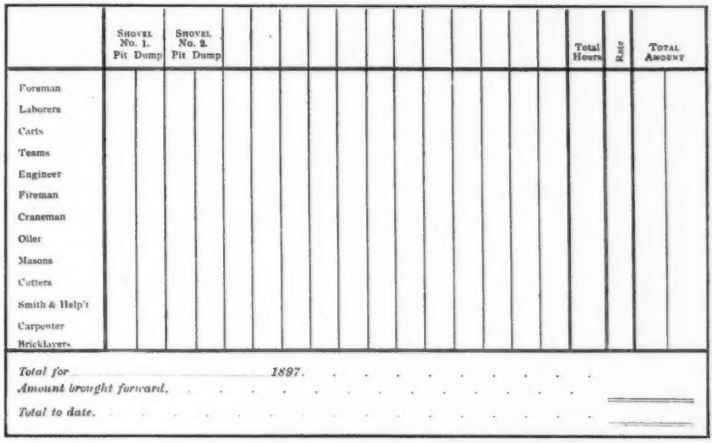
> "Our methods of keeping up costs and estimates are so crude and antiquated they would be of no service to you."
>
> "We endeavor to divide our accounts on building work as much as possible, but without the co-operation of a man on the work it is a very difficult matter to analyze correctly the different charges."
>
> "We are well aware that great improvement can be made in this direction and trust your efforts will be productive of beneficial results."
>
> "The only system we have of cost keeping on contract work consists in having our foremen on the different jobs send in postal cards every evening, stating number of men employed, bags of cement and yards of sand used, and the amount of work finished each day."
>
> "The method followed by us in distributing costs is simply to divide up each foreman's work day, charging to the different accounts the proper proportion. * * * * * * We do not use any special blanks for this purpose."
>
> "My system of book keeping is very simple, and I do not think it would be of much benefit to you as regards finding out some new or better methods of keeping contract accounts. First, we pay weekly. Each foreman has a book and the labor is charged up to his particular job. Second, bills for material are required to be rendered monthly, and such bills are charged up to the job on which they are delivered. Third, most of my work being contract work, there is no question about final estimates. Fourth, all expense is charged up against loss and gain at the end of the season."

The evidence of these replies and an extended experience with contract work is conclusive that many contractors need a good cost-keeping system. It appears that in some instances they do not have the "co-operation of a man on the work" and that they have no special blanks. That is to say they have no system. But special blanks and a system are entirely useless unless well adapted to the business and easily kept up. A contractor who devises a "system" with a dozen or more blank forms to be filled out daily, weekly, and monthly (and generally nightly) by foremen, bosses, timekeepers, etc., the posting of which would keep several expert accountants busy, may expect to see his "system" break down. It often breaks down before it gets fairly started. Such failures do not end with disappointing the contractor, but too often in bankrupting him and in deterring other contractors from adopting any "system." Horse sense and good judgment alone are better than an ill conceived system, but they may be greatly reinforced by a good system adapted to the business.

There will generally be found on any piece of work enough men with sufficient ability to co-operate with the management in accurately recording costs. Simple blank forms, that the men available can understand, will secure the desired co-operation. The essential thing is to devise a system with blank forms that is adapted to the capacity of the men who are available to carry it out and to the particular operations in hand. In devising such a system, it is necessary to start with a clear idea of the resulting information and distribution of costs which is the object to be attained. "A little well done is better than much badly done" is a maxim that applies with great force to cost keeping; therefore it is advisable not to attempt too much refinement in starting a cost-keeping system, but rather begin it in a simple way and improve it in detail as the requirements of the business and opportunities present themselves.

I was once assistant engineer in charge on a small railroad contract and received instructions from the chief engineer to "keep as accurate an account as possible of the contractor's expenditures, both for labor and material." The only available assistance for this work was about half the time of an ordinary boy with a common-school education, whose salary was about $40 per month. A material book was opened in which were entered all materials received on the work, in accounts classified as cement, stone, lumber, broken stone, etc. Whenever possible, the quantities were verified by comparison with the way bills. The contractor's statements, verified by market prices, were accepted for the cost.

The labor account was kept in books, specially designed for the work, one page being used for each day. Below is shown a fac-simile page of these books. The labor on each section, station, or structure being kept in separate vertical columns, and the classification of the labor on the horizontal lines, as shown, the segregation of cost of labor for each part of the work or for each class of labor was permitted, if required. The total hours of each class of labor multiplied by verified rates gave the total labor cost for the day, which added to the amount brought forward gave the total labor cost to date.



	Shovel No. 1. Pit	Dump	Shovel No. 2. Pit	Dump														Total Hours.	Rate	Total Amount	
Foreman																					
Laborers																					
Carts																					
Teams																					
Engineer																					
Fireman																					
Craneman																					
Oiler																					
Masons																					
Cutters																					
Smith & Help't																					
Carpenter																					
Bricklayers																					
Total for ..... *1897.*																					
Amount brought forward.																					
Total to date.																					

REDUCED FAC-SIMILE OF BOOK FOR DISTRIBUTION OF LABOR ON CONTRACT WORK.

When the work was about half completed, the contractor told the president of the company that he was losing considerable money, but could not tell how much. In less than twenty-four hours from receipt of instructions, a full report was prepared from the records described above and from the measurements of work done, showing what had been earned under the contract, and that the cost to the contractor had exceeded the contract prices by a large amount. While this account was not exact, it was probably not more than 1 or 2 per cent. in error and was much closer than any statement the contractor was able to make. On the face of it, a well-known and very able railroad president gave the contractor a large bonus over and above his earnings, under the contract. This was, in this particular case, good policy on the part of the railroad company, but it was also an act of justice, and is described here to illustrate what even a very simple cost-keeping system can accomplish.

It is not material that the cost was kept by the railroad company's engineers in the case just described. If the contractor could have produced a record as clear, complete, and as well verified the result would have been the same.

An instructive example of the lack of an effective cost-keeping system was the experience of a contracting company, which went into voluntary liquidation on the conclusion of thier sixth contract, pocketing a net loss of about $30,000. They executed a contract for about 25 miles of heavy road grading and masonry, on which work they employed three auditing accountants under a treasurer or paymaster, who was an expert accountant. They were supplied with a large number of special blank forms and books, for the purpose of keeping a full distribution of costs. Owing to "the pressure of other work" these forms and books largely remained blank, and if they had not, it is doubtful if they could ever have been made to disclose much information of value. The "system" was top heavy and was not at all adapted to the conditions or to the work. When this work was nearly completed, the managing director of the contracting company came to the conclusion that the engineers were not giving them, in their estimates, either the quantities or the classification which they had earned.

They thereupon employed an engineer to go over the work and make up a complete estimate. They were fortunate in being able to secure a set of the original cross sections, which are often withheld from the contractor, particularly when a dispute is in prospect. The result of this remeasurement showed that the work had been underestimated by nearly $20,000, mostly in quantities but partly in classification. To avoid a lawsuit, they accepted a settlement of about 60 per cent. of their just claims. On items where they could show actual and accurate measurements, their claims were allowed, and these included an increase of $5,000 in quantities for seven-eighths of a mile of solid rock excavation.

The conclusions to be drawn from this are:—First, if they had employed an engineer to make independent measurements and estimates from the very beginning of the work, they would very likely have secured about $8,000 more in the final settlement. Second, the differences could have been largely settled each month instead of at the end of two years, at which time many things were forgotten and witnesses out of reach. Third, that a cost-keeping system on general contract work should include a system of independent monthly measurements and estimates. Fourth, that on grading and similar work,

the contractor should secure the original cross sections before opening up or disturbing the surface or ground.

The fourth conclusion may be more clearly brought out by relating an incident in a suit of a contractor against a railroad company for about $100,000, on the claim that the engineers of the railroad company had underestimated his work by that amount on two very heavy sections. He produced as witnesses several engineers who had cross-sectioned the work several years after its conclusion, and who substantiated his claim. The railroad company, in defence, submitted the notes of the original cross sections, which showed that, on the two sections concerned, the line followed an old grade which had been excavated some 30 years previous to the time in question. If this contractor had kept even approximate notes of the original cross sections, he would never have incurred the expense and trouble of bringing suit on such a claim.

While considerable losses may sometimes be saved in final settlements by adequate records of costs and quantities, this should be considered only a secondary or incidental result, the principal and most profitable object being to locate wastes and inefficient expenditures in the beginning, so that they can be corrected and the leaks stopped. In the illustration cited above, where independent monthly measurements and estimates would probably have saved $8,000 to the contracting company, a cost-keeping system could have been carried along with the monthly estimates, without materially adding to the expense, which would have saved them over $20,000 by promptly pointing out where the leaks occurred.

Cost-keeping systems on contract work should generally be devised with both of these objects in view, as they naturally go together.

Young engineers, with a few years' experience, should usually be found to be well qualified for the work, under the direction of an experienced manager. If proper managerial direction is lacking, more experienced men will be required. Other things being equal, men with a technical training should be able to bring to the task a mental equipment by which the maximum of results may be obtained at a minimum of expenditure.

Distributions of cost require a record of the quantities to which they refer, and therefore the measurements and estimates must be taken for the same periods that the distributions are desired to cover; --weekly, bi-monhly or monthly. Engineers' monthly estimates will generally be found unsatisfactory, if not wholly useless for this purpose, not being properly segregated in detail for the purpose of cost

distribution. The work of making independent measurements and estimates is not difficult when properly attacked, and it can easily be carried along with the cost keeping. If the man in charge of the cost keeping has some engineering training, little or no additional cost will be incurred. The value of independent measurements and estimates to the contractor is, for many cases, almost self-evident.

A very great saving in labor and cost will often result from the use of approximate measurements and methods in preparing the partial estimates of work done for any short period. The resulting cost per unit of quantities will be sufficiently accurate for all practical purposes, and can be made available for the use of the manager much sooner than where exact or precise methods are used. Approximations must always be used with judgment, or they will not be safe, and their limit of error or degree of accuracy should be established closely.

The value of a cost-keeping system decreases as the time required to work out the results increases. If the manager or superintendent could know on Monday morning just what his unit costs were for the past week, he could make better use of the information than if it was not available until a month later. A successful contractor once said, "I cannot get my costs in time to use in making up my bids for work in the following year." The value of his cost keeping was evidently only historic. Even if the costs on one piece of work are only obtained in time to use in preparing the next bid, the results are of somewhat doubtful value. What we would like is, to know today what it cost, for instance, to lay concrete per cubic yard yesterday; how much for materials, for handling, for mixing, for placing, for forms, for power, for plant, etc. But this would be ideal and far better than we can hope to accomplish. A practical and reasonable rule would be to have the unit costs in detail tabulated for use within 48 hours to four days after the close of the last day's work of each weekly, fortnightly, or monthly pay-roll period.

In some cases it may be found desirable to have the unit costs computed and tabulated for each calendar month, in which case several pay rolls, or parts of pay rolls, would generally be included. With a complete system and modern tabulating and computing facilities, unit costs can be computed without reference to the pay-roll periods. Special reports can be quickly made at any time and covering any part of the work or period of time.

It is expected to follow this with articles descriptive of systems actually used, and outlining a complete system employing the readily available modern ideas and appliances.

EDITORIAL COMMENT

IT is hinted in well informed circles in Washington (and elsewhere) that if the suddenly prominent enthusiasm for a sea-level canal at Panama were traced back to its ultimate sources, some of these might be found to be of very doubtful purity—or, rather, of very definite impurity. This is not by any means to say that there is not a sincere and honest party in favor of that plan. Let us hasten, in all frank, ness and courtesy, to acknowledge the good faith and the ability of many of its supporters, and the weight of some of their arguments. But the statement is made, apparently with much to support it, that the livery of this party has been seized as a cloak by wholly selfish interests whose sole purpose is to delay as long as possible the completion of any canal connecting the oceans.

It is earnestly asserted, in short, that the sea-level proposition has received its most specious presentation through the influence of a certain *claque*, whose mission it is to work up an apparent popular enthusiasm for a project which will involve long preliminary discussion, the delay and uncertainty of wholly new plans, and finally the maximum of time for construction and opening of the canal. The interests (so it is said) which first fought bitterly against any canal at all, and then covertly for an impracticable location for a canal, are now fighting craftily for a type of canal which will delay the opening and give them an extension of their monopoly for full ten years longer than they would retain it if the lock canal were built. These interests are the Transcontinental railroads.

* * *

IN connection with the present interest in the question of accidents on railways there has been shown a tendency to compare the methods of investigating disasters and reporting accidents in Great Britain with those existing in America, and in some quarters the reports of the Interstate Commerce Commission upon accidents have been rather severely criticized.

It is impossible to compare the reports of the Interstate Commerce Commission with those of the Board of Trade, simply because the conditions under which the two bodies act are not the same. That the methods of the Board of Trade are not perfect may well be admitted, but that they are superior to those of the Interstate Commerce Commission has been maintained by some who deplore the present agitation about accidents on American railroads. For this reason it may be of interest to note the extent to which the powers of the Board of Trade exceed those of the Commission. Thus, in connection with its supervisory powers over British railways, the plans for any railway construction are required to be deposited with the Board of Trade before any bill can be introduced into Parliament; and before any railway can be opened for traffic the permission of the Board must be obtained, on the report of an inspector. Since the block system is compulsory in England, this portion of the equipment is included in the inspection, the

entire signal system and interlocking plant being subject to the approval of the Board of Trade, after a report by its inspectors. The railways are required to give notice to the Board upon the occurrence of any accident, and all the circumstances must be placed fully before an inspector of the Board, sent to the spot for the purpose; and on the report of this inspector the Board is empowered to take such steps as may be judged necessary for the security of the public.

American railroads would probably make serious objections to the granting of such powers to any official body, but that they have made for safety in England seems to be beyond denial, and with such an example before us we can scarcely plead ignorance of at least one way to reduce the number of railroad accidents.

* * *

THE approaching International Railway Congress at Washington will doubtless result in much good in connection with the interchange of opinions and experience in various departments of railway construction and operation. Among the points to be considered it is to be hoped that the question of standard rail sections, material, and methods of testing will have a place. As was long ago pointed out by Mr. James W. See, in a paper on standards, presented before the American Society of Mechanical Engineers, the acceptance of a standard does not necessarily mean that anybody is obliged to conform to it, but merely that it becomes a definite and accessible record, which can be used in framing a specification or in establishing an agreement without the necessity of redescribing what has already been precisely described and recorded.

At the present time there are a number of specifications and sections for rails which differ but slightly in minor matters, and which might well be discussed in the hope that fruitful and useful suggestions may be brought forth from men who, above all others, are best fitted to treat the questions included.

* * *

THE interesting figures of the increase of road-repair costs under motor-vehicle traffic, given by Monsieur Périssé on pages 901 903 of this number, bring out again a very important point which was well put in Col. Sylvester Stewart's article in our issue of July, 1903. It is often overlooked in the comparison of various modes of transport, with the result that the inquirer is led to false conclusions. Briefly, it is that the moving vehicle is only one element in the economy of transportation. The other, and really the more important in many respects, is the permanent way on which that vehicle runs. No concept of the subject is complete and no comparison true unless both of these factors are adequately rocognized and given their proper proportionate value. The question "what will be the place of the automobile in the civilization of the future?" is inseparable from the question "what will be the roads of the future?"

With Col. Stewart's permission, we quote from a recent letter received from him :—

> "On pages 118, 119, and 121 of 'Modern Industrial Progress,' just issued, the distinguished author has done me the honor to quote at considerable length from my article in THE ENGINEERING MAGAZINE on 'The Automobile and the Railway as Transport Agents,' but he thinks that greater changes than I anticipate will occur in five hundred years.
>
> "Five-hundred years, however, will make no change in the composition of materials. Sugar will still be sweet and vinegar sour, and steel roads will still be smoother, stronger, and more durable than stone; from which smoothness, strength, and durability result the advantages I pointed out."

REVIEW OF
THE ENGINEERING PRESS.
"THE WORLD IS ITS FIELD"

RAILWAY ACCIDENTS IN ENGLAND AND AMERICA.

AN EXAMINATION OF AMERICAN AND BRITISH REPORTS ON RAILWAY ACCIDENTS AND THE CONCLUSIONS WHICH CAN BE DRAWN FROM THEM.

Slason Thompson—Western Railway Club.

THERE is no question, at the present time, as to the interest which is taken by nearly everyone in the question of accidents on railways; and on the part of Government officials, railroad authorities, and the traveling public the subject is admitted to be one for discussion, study, and action. The paper of Mr. Haskell, published in the December issue of this Magazine, together with the reports of the Interstate Commerce Commission, have attracted wide attention, and there is ample evidence that the agitation will continue until some remedial action is taken to diminish the number of casualties, especially on American railroads.

In such a matter it is most important that any premises should be founded upon accurate and reliable information, and especially that any attempts at comparisons between the conditions in different countries should be based upon data which are strictly comparable. This side of the question has been brought out by Mr. Slason Thompson in a paper presented before the Western Railway Club, and some abstract of his discussion is here given as bearing upon an important element in an important matter.

In the first place it is to be noted that comparisons are frequently made on one side between the number of accidents to passengers and the total number of accidents to all persons, employees included, on the other. Thus the report of the Board of Trade for 1901 showed that not a single passenger had been killed in a train accident in Great Britain, and this noteworthy fact has been compared with the great loss of life reported on American railroads. As a matter of fact, however, the same report of the Board of Trade showed that the total number of personal accidents during the same year on British railways amounted to 1,277 persons killed and 18,735 injured, these, however, not being passengers. Mr. Thompson very properly objects to a comparison of a part of the report of accidents on British railways with the total on American railroads.

The British reports include a classification of the character of the accidents, together with a comparison between the number of accidents and the corresponding number of persons exposed to accident as well as a review of the tendency of accidents to increase or diminish. It is intended also to distinguish between preventable and non-preventable accidents, the whole intent being the collection of information, not for the mere sake of publicity, but principally with a view of determining the best methods of diminishing the number of accidents of all kinds in connection with railway operation. The work of the Board of Trade in this connection is in the hands of a special department, the inspection staff being composed almost entirely of officers of the Royal Engineers. It must be remembered that the Board of Trade is a Department of the Government, with extensive supervisory power over the conduct and operation of railways, such as would seem very onerous in the United States,

and among these powers is included the inspection of all railway accidents, the railways being required to give notice in every case of accident, sending for an inspector, whose report is made the occasion of the exercise by the Board of its power to take such steps as are necessary, in its judgment, to provide for the security of the public.

It has been maintained that, in any comparison between British and American railways, the difference in mileage should be taken into account, but this seems hardly a correct basis for comparison, and a more rational one would appear to be the number of passengers carried, although the connection in this case is by no means positive. The great disparity between the number of passengers and the number of employees killed is in itself an indication of the greater degree of relative risk in the latter case, and indeed this feature is emphasized by the fact that some accident insurance companies give increased indemnity to policy holders who may be injured while traveling in public conveyances, thus distinctly recognizing that the individual is safer in the car than elsewhere. It is therefore most desirable that the reports of the Interstate Commerce Commission should so classify the accidents as to enable the separation of passengers from employees, and especially to indicate the nature of the accidents by which so large a number of employees are injured. It is hardly to be expected that this latter information could be obtained from the railroad companies, but if the Interstate Commerce Commission were given the same powers as the Board of Trade in this respect, a long step forward would be taken toward making the two reports comparable.

An interesting statement in Mr. Thompson's paper appears when he makes the following remarks about block systems:

"The accident reports of the Interstate Commerce Commission, prejudiced as they are in favor of the block signal system as the panacea for railway accidents, cannot wholly conceal the fact that recklessness, negligence, and disobedience in the human equation is mainly to blame for railway accidents. In three cases out of four where the block system is installed the failure of the human equation to keep it in order, or to observe or to obey its warnings, neutralizes its efficiency. The inevitable tendency of the block signal system is to beget carelessness in the train crews, as it shifts responsibility to the signal system operators or to the signal itself."

The best comment which can be made upon this statement is that given in the discussion by Mr. Tratman, which we here quote:

"Mr. Thompson states that, in his opinion, the absence of safety devices has little to do with safety in operation, and that recklessness, negligence, and disobedience in the human equation are mainly to blame for railway accidents. He states further that he approves of block signals wherever practicable, and where they will insure public safety without overburdening public traffic (evidently failing to realize that the block system is an aid to the prompt and efficient handling of traffic). But in the next sentence he says the inevitable tendency of the block signal system is to beget carelessness in the train crews. If this 'inevitable tendency' exists it is difficult to see why Mr. Thompson should favor the system at all, but as a matter of fact this 'tendency' is imaginary.

"In England the railway system has nearly the entire mileage (and certainly all of its main-line mileage) operated under the block system, subject to the rules of the Board of Trade. If English railways had the same small percentage of length equipped with block signals as in this country, the accident list would undoubtedly be very much larger. In fact, with the density of traffic of English railways it would be impossible to handle the train service safely or efficiently without the block system. In England, the use of the block system is compulsory, and no railway can be opened for traffic until its track and equipment (including signals and interlocking plants) have been inspected and approved by the railway department of the Board of Trade. As to discipline, it is well known that English railway employees are less apt to disobey orders and signals or to take chances than are the employees of American railways. This is largely due to the fact that the former have for years been trained to observe and obey signals implicitly as their main guidance in running the trains."

It should hardly be necessary to observe that the real responsibility is a matter which lies higher up than with the train crew, and that a part of the duty of officials in charge of the conduct of transportation is the enforcement of the operation of signalling systems as well as of their installation. No military officer would think of endeavoring to shift the responsibility of matters entrusted to his command to the shoulders of his inferiors, and it should be well understood that the acceptance of responsibility is the real attribute of high office.

Many years ago there was much the same sort of agitation in England concerning railway accidents as now appears in the United States, and it was then that Leech's famous cartoon appeared in *Punch*, showing that the proper way to prevent accidents on railroads was to lash a director of the company to the front of each locomotive. England has benefited by that agitation by the enactment of the very powers for the Board of Trade to which Mr. Thompson has so fully referred, and the lesson is one by which America may also learn what is best to be done.

MAIN-LINE ELECTRIC TRACTION.

AN ARGUMENT FOR THE REPLACEMENT OF STEAM LOCOMOTIVES BY ELECTRIC TRACTION FOR THE HEAVIEST FREIGHT SERVICE.

H. Ward Leonard—Electrical World and Engineer.

ONE of the most difficult things to obtain, in considering the replacement of a process, method, or line of business conduct by something new, is the establishment of a correct basis of comparison. In nearly every instance the existing thing is used as the standard and the proposed plan is compared with it, usually upon some selected line, such as gross cost, equality of capacity, or some partial consideration, according to the ability or prejudices of the person having the matter under consideration. As a matter of fact this is not the way that changes are really made, and, indeed, great alterations in the conduct of important enterprises are rarely made as a consequence of deliberate aforethought, but usually follow as the result of a slowly accumulating external pressure which ultimately becomes too great to be resisted.

In the case of the comparison between steam and electric locomotives for main-line service the basis usually taken has been the cost of conducting the traffic with the present equipment, and when it has been shown that little or no gain would result in doing the same work in the same way, merely substituting electricity for steam as a source of power, the question is complacently assumed to have been answered. The absurdity of such a method readily appears if it is compared with changes which have really been accomplished. Thus, for example, any attempt to have considered the relative values of steam railways and with the former system of stage coaches and horse-drawn teams, by examining the cost of doing the same work as was performed by the horses, if steam power were substituted, would have shown an enormous increase in the capital invested, and a far larger operative cost. In like manner the cost of propelling a vessel by steam as compared with the use of wind power for the same displacement and speed would make but a sorry showing for the steamship. Trolley cars of the same size, weight, speed, and number as the old horse cars of any street railway system, would prove a costly and unprofitable substitute, and so with any other transformation which might be cited.

These thoughts are brought out in connection with an article by Mr. H. Ward Leonard in a recent issue of the *Electrical World and Engineer*, in connection with the discussion of the probable substitution of electricity for steam for hauling freight on main-line railways.

Railway men are all fully impressed with the fact that the freight receipts depend upon the ton-mile, and that the expenditures are, under present conditions, a function of the train-mile, and under these circumstances they naturally bend their energies toward the increase of ton-miles and the reduction in train-mile costs. It is

upon this entirely correct principle that Mr. Ward Leonard approaches the question, with the result that some very interesting conclusions appear.

In the first place it is increasingly evident that the limitations of the steam locomotive are being closely approached.

"A modern compound freight locomotive, which produces about 1,400 h. p. at 18 miles per hour, with a pull at the drawbar of 30,000 pounds, can produce as a maximum about 50,000 pounds drawbar pull, but to do so will have to reduce its speed to, say, three miles per hour, and will then produce only about 400 h. p.

"It is a most unfortunate fact for the steam locomotive that just when the heaviest grade is encountered and the demand exists for from three to six times the power required on the level in order to maintain sufficient speed to prevent traffic congestions, the power of the steam locomotive, instead of increasing in response to this temporary demand for increased power, actually falls to about one-third or one-half of its maximum power.

"The boiler is the limiting feature of the steam locomotive. There is a limit to the steam pressure which can be efficiently employed. There is a limit to the amount of coal which can be burned on the limited grate surface in the limited firebox. There is a limit to the work which the fireman, or even two firemen, can perform in stoking. All of these limits have been reached, or practically so, in the modern high-powered steam locomotive, and whatever this limit may be in favorable weather, it is again greatly reduced by conditions of extremely cold weather, when the reduced steaming capacity of the boiler, the reduced physical strength of the fireman and the bad track surface, all unfavorably affect the production of the increased horsepower needed to maintain schedule speed."

The compound system has extended somewhat the hauling capacity of engines by the higher efficiency with which the steam is used, but in the great engine exhibited at St. Louis, with 5,600 square feet of heating surface and about 2,500 horse power, the limitations are closely reached. The 80,000 pounds drawbar pull which this engine can exert is about all that existing equipments can stand.

It is evident that any system which is to supersede the steam locomotive for freight service must do much more than compete with that machine, it must take up the work where the steam locomotive is compelled to leave off. Freight must be hauled in longer trains, at higher speeds, and up steeper grades, if the cost per train-mile is to be further reduced, and upon the reduction in the train-mile cost to the railroad depends the reduction in the ton-mile charge to the shipper.

The fitness of the electric locomotive, operated in multiple unit, with as many locomotives to a train as may be necessary to do the work, is seen by the fact that the electrically propelled machine is capable of exerting a pull of 125 pounds on the drivers per horse power, while the maximum for the steam locomotive is about 117 pounds.

"Just as in the former street car practice a light car was essential when the power was limited to horses, and the horses laboriously moved the car on a 6 per cent. grade at a slow speed, so the modern steam locomotive, with its limited power, moves the relatively light freight train at a slow speed on the mountain grade, and just as the gigantic trolley car of to-day rushes at nearly full speed up a grade of 6 per cent. driven by a source of practically unlimited power and responding without injury to the demanded production for a short time of some six times the power needed on the level, so will the future electrically-driven freight train rush up the present mountain grades at a speed which will make the speed of to-day on mountain grades seem ridiculous.

"If one per cent of the money spent per annum in the reduction of grades and the strengthening of curves were spent in building electric locomotives and power plants to use them, where increased power is needed, most of the vast sums being blasted and shoveled away would be saved and a far better economical result would be obtained than can ever be hoped for by the use of steam locomotives.

"Let us now look briefly at the effect which would follow a possible reduction in the cost per ton-mile. Most people, no doubt, think that the cost of the ton-mile is a matter of little concern to them. The

railways of the United States were paid by the inhabitants of the United States in 1903 for producing 173,221,000,000 ton-miles; that is, every man, woman and child in the United States paid to the railways, as an average, last year, the price of 2,160 ton-miles; 8 tons were moved over 250 miles for every inhabitant of the country. In 1893 the per capita production was only 1,430 ton-miles. In 1880 it was 645 ton-miles per capita.

"The inhabitants of the United States paid to the railways last year for freight transportation at least $1,320,000,000. It will be evident from these figures that the price paid to railways per ton-mile vitally affects the per capita income and wealth of this nation and a material reduction in the ton-mile selling price is an important source of wealth.

"To illustrate this the reader need only be reminded that the enormous wealth of the Standard Oil Company was built up out of a small percentage rebate on the ton-mile price.

"On account of competition the railways have thus far promptly given to the public most of the benefit due to savings effected in producing the ton-mile. In 1903 the average selling price of the ton-mile was .76 cent. In 1893 it was .88 cent. In 1890 it was .94 cent. The ton-mile price has, therefore, been reduced 20 per cent. since 1890. If the freight moved last year had been paid for at the rate which prevailed in 1890, the public would have paid to the railways last year $312,000,000 more than it actually did pay. This enormous annual saving is equivalent to dividing among the inhabitants of this country a dividend of 2½ per cent. upon the $12,600,000,000 of railway stocks and bonds outstanding in this country. It is practically equivalent to dividing among the inhabitants of the United States all the gold annually produced in the world.

"It seems safe to say that the most important factor in the recent enormous production of wealth in America has been the startling reduction in the price of the ton-mile.

"Enough has been said to make it clear that there is no subject in which the general public is more interested than in the cost of production of the ton-mile. It is hoped that sufficient evidence has been presented to make it clear that economies in the production of the ton-mile are radically influenced by the amount of power than can be commercially applied to a freight train."

It is evident that if the question of steam and electric traction for main-line railway service is to be considered intelligently it must be upon the basis, not of present conditions, but upon the extent to which electricity may be used to carry the train-mile capacity far beyond present limits, and thus reduce the cost of the ton-mile, both to the railroad and to the shipper.

THE ECONOMIC VALUE OF CAST IRON.

THE PRODUCTION OF MACHINE CASTINGS OF MAXIMUM STRENGTH, UNIFORMITY AND SATISFACTORY MACHINING QUALITIES.

W. H. Pretty—Manchester Association of Engineers.

IN these days of steel it is possible that insufficient attention is given to materials of construction which are still very largely employed, and which, if considered in the light of improved methods of production and operation are undoubtedly susceptible of partaking to a greater or lesser degree in the advantages of scientific manipulation. It is beginning to be acknowledged that for some purposes wrought iron is distinctly better than steel, and it must be admitted that cast iron is yet one of the most extensively used materials in the machine shop, and yet it is only recently that the foundry and its products have been given anything like the amount of scientific attention which has long been accepted in the manufacture and use of steel. In a paper recently presented before the Manchester Association of Engineers, Mr. W. H. Pretty discusses the economic value of cast iron in the light of present shop methods, and some abstract of the paper will be found of interest.

"The value of cast iron in the arts and manufactures of the world is such that it

must necessarily take an important place in the great industrial questions of the day, while the vast supplies held in store for us by nature, of ores of iron and fuels, and sources of energy capable of being utilised for the production of heat by electrical or other means, are sufficient indication of its continued use by man in the future. It behooves us, therefore, as engineers to give the subject all the attention we can to develop it to the best of our ability, and endeavour to make the founder's work a sure science. The most important applications of cast iron (under which term is included pig-iron) at the present time may perhaps be broadly classed as follows:—

"(1) Its use in the production of wrought iron, steel and ingot iron, &c., essentially of a metallurgical nature.

"(2) Its use in the service of mankind by civil engineers and others for structural work, bridges, tunneling, pipe lines for water supply, and other purposes.

"(3) The production of castings for the general use of mechanical and electrical engineers in the construction of machinery, steam engines and other prime movers, &c.

"(4) The reproduction of works of art, ornamental ironwork, and various articles required for domestic and other purposes in times of peace.

"(5) The manufacture of malleable castings.

"The field covered is a very wide one, Class 2 is gradually passing into the hands of iron founders possessing blast furnaces, for obvious reasons, but is still practiced on a small scale by founders engaged in Class 3, while it would seem that Class 5 is likely to be replaced by steel castings."

The exact definition of the term cast iron is almost as difficult as the precise meaning of the term steel. According to Professor Howe cast iron is defined as iron containing more than 2 per cent. of carbon; just as he defines high-carbon steel as iron with a carbon content between 0.30 per cent. and 2.00 per cent., and low-carbon steel as iron containing less than 0.30 per cent. of carbon. Mr. Pretty is much less definite than this, as he broadly defines cast iron as iron, with the addition of small quantities of carbon, silicon, sulphur, phosphorus, manganese, and "anything else it can lay its hands on."

"Cast iron is frequently described as occupying a place in the iron carbon series, but it is something more than this, its composition is of an exceedingly complex nature and it should really be regarded as the product of a process in which other materials, in addition to iron are reduced by the action of fuel and blast and enter into combination with it. In addition to these we may have compounds formed without the direct reduction of the elements and it is not at all unreasonable to suppose that interchange between compounds and elements takes place in solution at high temperatures analogous to those we obtain in the chemical laboratory in solutions at normal temperature. It is customary to-day to judge the suitability of a pig iron for foundry purposes by the carbon, silicon, sulphur, phosphorus and manganese present. Before long we shall have to pay more attention to other elements such as chromium, arsenic, copper, titanium, etc., and their behaviour when in solution or combination with irons, in quantities so small that we to-day ignore them."

After enumerating the more frequently employed ores of iron, and the processes used in the production of pig iron, Mr. Pretty discusses the ordinary methods of grading and classifying the product. Formerly the old method of determining the character of the metal by the fracture of the pig was considered sufficient, but this can no longer be accepted. The increase in varieties together with the changes in structure due to the production of machine-moulded pigs cast in chills demand some more precise method, and the use of a combination of chemical analysis, united with physical and mechanical tests, must be advocated. Of course an accurate knowledge of the pig is by no means everything, since the advantages of the most careful choice of materials may be completely upset in the foundry by careless working at the cupola, the use of improper fluxing materials, blast conditions, casting temperatures, and other elements of manipulation.

There is no doubt that by the use of chemical and physical methods of examination, both as applied to the pig and to the resulting castings, the conditions giving any desired result may be discovered.

and a repetition of any determinate series of operations be made to give a desired product.

The present interest in the introduction of rapid machining processes, including high-speed steels for the cutting tools and more powerful machine tools in which to do the work, has emphasised the demand of the machine shop upon the foundry for soft and easy-cutting castings. As Mr. Pretty well says, however, the question arises, which is the more important factor, the economic value of the material, of the output of the machine departments? In many cases the strength is ample and the cost of machining is paramount, but there are many others in which the material must take premier position. Mechanical tests show conclusively that metal which would be hailed with delight and satisfaction on the shop because of its softness, may be unsuitable to meet the conditions of stress and wear which are to come upon the finished product. Mr. Pretty urges the importance of including among the tests for cast iron that of its machining quality, by the provision of test pieces to be subjected to the lathe and the drill, so that information upon this important class of properties may be included with those of resistance.

In this connection a form of standard test is given, readily available for trial in the lathe as well as in the drill-press and boring mill.

"To enumerate a few of the questions bearing upon the manipulation of cast iron throughout its treatment in the foundry we have:

"The formation of suitable slag in the cupola.

"The behaviour of the blast and possible occlusion of gases in the cupola under bad working conditions.

"The addition of minute quantities of reducing agents, such as ferro-aluminium, ferro-silicon, ferro-manganese, (silicon-aluminium-manganese alloys), etc., to the molten metal while in the ladle.

"The pouring temperature and the study of cooling curves by means of thermometers specially suitable for the work.

"The behaviour of moisture and gases at the high temperatures suddenly brought to bear upon them, and ranging from 15° C. to 1,600° C. or higher, and their behaviour when in a state of occlusion, solution or enclosure in a mass of cast iron, capable or incapable of yielding to the pressure produced.

"The occlusion of gases by molten cast iron and their retention or throwing off as the metal cools down to the solid state, and the effects of rapid cooling upon this phenomenon.

"The possible liberation of gases within the mass of molten metal as it cools down, and due to molecular and chemical change other than that accounted for by occlusion.

"The effects produced by various degrees of moisture in the sand composing the mould, upon the metal in contact with it, and methods of determining the percentage of moisture in the facing and other sands used in forming the moulds. The shrinkage of cast iron as it cools down from the molten state, and its sudden expansion when nearing the point of solidification, afterwards followed by the usual contraction of solids as its temperature falls.

"The remelting of foundry irons and the change in character of the chemical constituents, and means of remedying this as required.

"The diffusion of metals.

"The heat treatment of cast iron and molecular rearrangement.

"The decay of cast iron under various conditions of employment, and means of remedying this.

"The effect of casting temperatures upon special chilling work.

"The study of eutectic and other alloys within a mass of cast iron, and the physical changes which accompany them.

"The various types of furnaces in use for remelting pig irons for foundry purposes ,etc., and the nature of the blast capable of giving the best results."

In the United States the study of cast iron and of foundry work has been effectively conducted by the American Foundrymen's Association, and it is a matter for congratulation that a British Foundrymen's Association has recently been formed, since it is only by interested co-operation of the men who are actually doing the work that the same progress may be expected in this as has been made in other departments of metallurgical work.

THE STRENGTH OF CONCRETE.

EXPERIMENTAL RESEARCHES INTO THE RESISTANCE OF PLAIN AND REINFORCED CONCRETE TO VARIOUS STRESSES.

Professor Mörsch—Schweizerische Bauzeitung.

WITH the extending use of concrete in construction there has arisen a demand for later and more accurate information, both as to the resistance of the plain concrete itself and in connection with various methods of adding a metallic reinforcement. The technical journals have contained many articles, bristling with mathematical equations, and evolving elaborate formulas, while the amount of reliable data upon which these superstructures have been reared is comparatively small. For this reason every contribution to the moderate stock of reliable experimental knowledge in this important and increasing department of engineering work is to be welcomed.

In recent issues of the *Schweizerische Bauzeitung*, Professor Mörsch gives a very clear account of some experimental tests made by him, showing their connection to the theoretical relations actually existing in members of concrete and metal, in connection with shearing and crushing stresses.

The tests made by Professor Mörsch, made in the testing laboratory of the Stuttgart Polytechnic, took into account the fact that in actual practice, especially for beams, crushing and the shearing forces are of the utmost importance, and hence he conducted the experiments with a view of determining directly the resistance to shearing action, as well as to crushing.

Theoretically, it is common to consider the forces in single cross-section elements of a beam, but in actual work the forces are not constant for any portion of the cross section, and it is necessary to take into account the changing action upon the whole series of successive elements of the cross section of the beam under consideration.

Professor Mörsch describes a number of tests of the shearing resistance of plain concrete, using a Martens testing press, and comparing the results with tension and compression tests upon concrete of the same constitution and age. In the brief theoretical study preceding the discussion of the experiments, it was deduced that the resistance to shearing should be the square root of the product of the tensile and the compression resistances, and this simple rule was well confirmed by the trials. Thus, for a concrete of the proportion 1 : 3, with 14 per cent. water, the shearing resistance, after two years, was 65.9 kilogrammes per square centimetre. Tension and compression tests upon the same material, of the same age, gave a tension resistance of 15.5 kilogrammes, and a resistance to crushing of 308 kilogrammes per square centimetre. The square root of the product of these two results is 69 kilogrammes for the theoretical shearing resistance. In another test the shearing resistance was 37.1 kilogrammes, while the tensile and crushing strengths were 8.8 and 172 kilogrammes respectively; the square root of the product being 38.8 kilogrammes per square centimetre.

When similar beams, reinforced by the imbedding of round iron rods near the upper and lower surfaces, were subjected to test for direct shearing, it was observed that fine cracks appear at about the same loads as caused failure in the non-reinforced beam, but that these cracks did not increase rapidly with increase in stress, and that failure was attained only when the shearing resistance of the reinforcing metal was reached. In these tests the shearing resistance of the iron rods was taken as 0.8 of the actual tensile strength.

In addition to the direct shearing tests, Professor Mörsch conducted a number of torsion tests upon short cylindrical pieces, both solid and hollow, these including pieces of plain concrete as well as those reinforced with imbedded rods forming spirals or helices of an angle of 45 degrees. This form of reinforcement was adopted because it was indicated by the direction of the cracks appearing in the torsion tests on plain concrete cylinders.

In these tests the cracks appeared in the concrete when the tension on the imbedded rods reached about 16,500 pounds per

square inch, this apparently being a point when the metal permitted the elastic limit of the concrete to be exceeded.

An interesting portion of the tests of Professor Mörsch was that upon the adhesion of imbedded metal rods and the concrete surrounding them. It has been assumed in some instances that the adhesion is proportional to the shearing resistance, probably upon the theory that the yielding takes place by the tearing of the concrete, a layer adhering to the metal. The experiments of Professor Mörsch, however, show that the resistance is the actual friction between the surfaces of the metal and the concrete, and that this depends upon the density of the concrete and upon the character of the surface of the metal. If the metal is rough, or of irregular form, and the concrete well rammed, the frictional resistance may exceed the shearing resistance, owing to the fact that hard pebbles, or other solid portions of the concrete become interlocked with the metal.

These experiments, conducted with a view of obtaining definite information, rather than with the intention of supporting any preconceived ideas, may be accepted as of material value in connection with an important and growing department of engineering construction, and it is only when theoretical investigations are based upon reliable data that practical and valuable results can be expected.

TELEPHONE LINE ENGINEERING.

MECHANICAL PROBLEMS CONNECTED WITH THE INTRODUCTION AND MAINTENANCE OF COMMUNICATION BY TELEPHONE.

C. J. H. Woodbury—Franklin Institute.

IN a paper recently presented before the Franklin Institute the problems of telephone-line maintenance were discussed by Mr. C. J. H. Woodbury in a manner well adapted to bring before the mind of the general reader the engineering features of a department of work concerning which there has been little published. The opportunities which are possessed by Mr. Woodbury for obtaining direct knowledge of the practical questions inseparably connected with the problem of telephone communication render his paper of much technical value as well as of popular interest.

By far the larger portion of the matter which has been published concerning the telephone is concerned either with the instruments of transmission and reception, or with the switchboard arrangements, but the fact that the very object of these terminal devices is the maintenance of communication over long distances makes it desirable that some attention should be given to the means by which those distances are spanned. At the present time there is in use in connection with the Bell telephone system in the United States approximately 4,000,000 miles of line construction, and when it is realized that this great investment is necessarily subjected to rapid depreciation, and that both for replacement and for continual extension ample provision must be made, some idea of the magnitude of the problem will be obtained. About forty-five per cent. of the Bell system's wires are on poles, and it is estimated that there are 6,300,000 poles in use, and that about 1,000,000 poles are required annually for replacements and extensions.

"The stresses to which a telephone pole is subject are the result of many and variable combinations of live and dead loads upon a beam fixed at one end and loaded near the other end. There is scarcely anything in engineering construction so actively the subject of depreciating conditions. The top is exposed to the weather, and the important section near the surface of the ground is the portion most energetically attacked by decay. The wood is assailed by animal life, whether it be gnawing by horses in town, or the perforation by woodpeckers in remote districts. Poles in wild countries are bitten by bears in search of bees, whose humming is imitated by the vibration of wires, and it is said that in India the tigers use the poles to sharpen their claws upon after the manner of their second cousins, the domestic cat, but with so much more vigor that the poles become weakened."

Apart from the questions of endurance to

climatic and general depreciation, and to the fixed stresses which are thus indicated there are varying and uncertain stresses for which provision must be made.

"A pole line is not designed merely on the basis of the stresses to which the pole is subjected in drawing the wires to the necessary tension, for in most northern climates the sleet will at times form upon the wires until they become icy cylinders perhaps three inches in diameter, and the problem is not that of the mere added weight, for the force of the wind blowing against this icy sail applies a greater horizontal load, which combines with gravity and produces a resultant force in a diagonal direction, greater than either of the contributing units.

"An ice-laden line swayed by the wind may be successfully resisted by the poles until the oscillations of the pendulum reach a synchronism with that of the vibration of some pole on the line which responds in like manner to the cumulative impact across the direction of the line, until it breaks this individual pole. Then adjacent poles are relieved of the pull on one side, and the excessive unbalanced stress breaks them.

"The most undesirable occurrences in connection with the wreckage of aerial lines are the disturbances resulting from the contacts of different electrical systems with each other, when the various lines are so near as to collide, when one or both break."

Passing to the wires themselves, Mr. Woodbury gives a general idea of the manner in which the stresses depend upon the form of the catenary curve assumed.

"The tension on a line suspended between a pair of horizontal supports varies with the sag and is at a minimum when the sag amounts to seven-twentieths of the span, and the tension increases whether the sag is greater or less than this proportion.

"For example, with No. 12 hard-drawn copper wire, weighing 173 pounds to the mile, and being 0.104 inch diameter, and having a span of 130 feet, the minimum tension of three pounds would occur if the sag was forty-three feet six inches, while it would slowly augment with increase in the sag, and if nature had furnished a chasm deep enough for the experiment, it would be expected to reach its breaking tension of 550 pounds at a depth of 16,470 feet, or 3.17 miles.

"On the other hand, the increase in tension proceeds rapidly as the wire is drawn to approach a straight line, the breaking tension occurring at a sag of one and one-half inches.

"As a comparison with this instance of the stresses in a local line, in the case of the No. 8 hard-drawn copper wire, 0.165 inch in diameter and weighing 435 pounds to the mile, as used on long-distance telephone lines, when the span is 150 feet the minimum tension occurs at a dip of fifty-two feet six inches, when it is only eight and three-fourths pounds, and in like manner, as in the foregoing instance, its breaking stress of 1,328 pounds would be reached at the slightly less dip of 16,100 feet, or 3.04 miles, still too great to admit of confirmation by direct experiment; but if the wire was pulled until the sag was 2.2 inches, it would require the breaking load of 1,328 pounds.

"It is desirable that the wires should be drawn tight enough to prevent them from swaying against each other; but it is important that they should not be drawn so tight that the contraction during extreme cold weather should cause the wire to break."

Mr. Woodbury refers to the Doolittle method of producing hard drawn copper wire, in which the omission of the annealing process during the latter portion of the drawing operation overcomes the lack of resilience, and prevents the continual stretching which otherwise renders copper unsuitable for overhead work. Since the value of copper scrap is only two cents a pound less than that of new copper there is a commercial advantage in its use over galvanized iron wire, which costs four cents a pound and has no scrap value.

The greatest difficulties in telephone line construction are naturally met in the mountain ranges of the Western States, and the combination of rough valleys, high elevations, snow, ice, and avalanches renders this portion of the work of the telephone engineer most difficult. These lines are frequently charged with atmospheric electricity which must be discharged

to the earth by bridging retardation coils across the lines and grounding the central part of the coils.

The actual gain in time by the use of the telephone for long distance communication appears in the statement of the fact that the actual time for the transmission by telephone between Boston and Chicago, a distance of 1,064 miles, is 0.006 second, while during the same time the voice is transmitted through the air but six and one-half feet.

The use of underground conduits in cities avoids many of the difficulties encountered with overhead wires, but they also have their share of mishaps. Thus the leakage of water and gas are both liable to produce serious results, while other underground work may cause serious interruptions and troubles. Still the underground system is well adapted for city use that fifty-five per cent. of the telephone-exchange wires are underground, and the number of wires in the conduits, in comparison with those upon poles, makes the number of miles of pole lines throughout the country seventy times the length of the streets occupied by the underground conduits.

At the present time there are more than 26,000 different settlements in the United States which are knit together by telephone communication, and the growth is continuous.

"During the last five years the number of telephones in the system has increased at a greater rate than ever before. This increase has been building upon itself like compound interest at the usurious rate of twenty-nine per cent. a year, and compounding each year at this rate would double the number in two and three-fourths years, or the number of telephones has actually increased over three and one-half times during the last five years.

"Each of these instruments as soon as installed comes into full service for connection with other instruments, and thus reciprocally each new telephone adds to the availability and, therefore, the value of those with which it may be in communication."

MECHANICAL CANAL LIFTS.

THE COMPETITION FOR IMPROVED METHODS OF OVERCOMING DIFFERENCES IN LEVEL ON THE LINE OF THE DANUBE-ODER CANAL.

Oesterreichische Wochenschrift für den Oeffentlichen Baudienst.

THE hydraulic canal lock is said to have been invented by the brothers Dionisio and Pietro Domenico, of Viterbo, in Italy, in the year 1481, a lock chamber with gates having been built by them in that year on the Piovego, a canal extending from Padua to Stra, and the device was promptly taken up by Leonardo da Vinci, who built six such locks on the Milan canals in 1497, after which the use of locks became general all over Italy and from thence in other parts of Europe. For nearly four hundred years no material improvement was made in the operation of raising and lowering canal boats, but with the development of internal waterways, and the inclusion of large differences in level, other methods have been devised. We have already noticed in these columns the hydraulic canal lift recently erected at Peterborough, on the line of the Trent canal, in Canada, this being the latest successor of the lifts at La Louvière, in Belgium, Les Fontinettes, in France, Henrichenberg, in Germany, and at Anderton, in England.

In the course of the plans for the proposed canal to unite the Danube and the Oder into one continuous waterway, it has been found desirable to arrange for a lift of 35.9 metres, or about 118 feet, at Aujezd, near Prerau, in Austria, and before deciding as to the best method of overcoming this elevation it was decided to institute a competition, open to engineers of all countries. No fewer than 204 designs were submitted in this competition, and the character of the premiated designs gives them especial importance in view of the increasing interest which is felt at the present time in the development of internal waterways in various parts of the world. In recent issues of the *Oesterreichische Wochenschrift für den Oeffentlichen Baudienst* the

successful plans are illustrated and discussed at length, and some abstract of the principal features is here given.

The design receiving the first prize belongs to the inclined-plane class, but at the same time it includes a number of characteristic features. The design includes a double-track inclined plane, with a slope of 1 in 25, the canal boats to be hauled up and lowered in tank cars containing sufficient water to float them, although the arrangement is also applicable to the hauling of the boats themselves directly upon dry cars, should this be found preferable. The arrangement differs from other inclined-plane systems in that there is no direct mechanical connection between the two cars, such as a cable, or other positive device, a form of electric balancing being employed instead, this leaving each car independent as to its own movements. The tank cars are each equipped with two electric-motor propelling cars, these being provided with two motors each, the motor cars forming a portion of the suspension of the lower portion of the tank cars, practically permitting the whole load to be pushed up the incline and held back during the descent. The continuous current motors are so arranged that they act as generators during the descent, thus returning to the system an amount of energy equivalent to that required for the ascent. The motors act, by a system of gearing, upon a gear-wheel and rack placed between the rails, in a manner similar to that successfully employed upon many mountain railways. The arrangements for receiving and discharging the boats are similar to those already employed with success in the hydraulic canal lifts, with special rubber packing for securing water-tight joints about the doors.

The inside dimensions of the travelling tanks are 71.21 metres long, 8.8 metres wide, and 3 metres deep, or about 233 by 29 by 10 feet, and it is estimated that the ascent of 118 feet, up an incline of nearly 3,200 feet in length, will be effected in 29 minutes. The plan includes a large number of details which appear to be very completely worked out, the various portions of the design, while submitted as a single plan in the competition, being due to such responsible establishments as the Bohemian-Moravian Machine Works, of Prague; Messrs. Breitfeld, Danek & Co., of Prague; Ruston & Co., of Prague; Ringhoffer, of Smichov; the Skodawerke, of Pilsen, and the Austrian Siemens-Schuckert Company, of Vienna.

The second prize design is marked by great boldness and originality, but the standing and responsibility of its sponsors, and the completeness with which it has been worked out cause it to demand attention and respect. This is nothing less than the use of a great revolving drum, made of a steel framework, and greater in diameter than the total height of the lift, besides being of sufficient length and strength to carry near its periphery two opposite tank cylinders large enough to receive the canal boats. The whole device resembles somewhat the Ferris Wheel at the Chicago Exposition, lengthened out into a cylinder, and it will be seen that a half-revolution of such a drum would raise a boat from the lower to the upper position, the height being limited only by the diameter of the cylinder. The design submitted in the competition involves a drum 52.6 metres (172.5 feet) in diameter, and 70 metres (229.6 feet) in length, this being large enough to raise boats 225 feet long by 26 feet wide, over the difference in level of 118 feet required by the conditions of the competition. These dimensions are quite within present experience, the Ferris wheel being 250 feet in diameter, and the lengthening adding to the stiffness of the construction without introducing any structural difficulties.

The large drum is supported by floating in the lower dock from which the canal boats are to be lifted, the journals at each end serving only to steady and guide the whole during the revolution.

The drum is driven by gearing around the periphery, using electric transmission from a power house in which it is proposed to use Diesel motors as prime movers. The power required is only that necessary to overcome the frictional and inertia resistances, as the whole affair is always in balance, the weight of the opposing boats and tanks being always equal. The usual water-tight doors are required for the boat tanks and for the upper canal terminal, but not for the lower, as the main drum is immersed in the lower ter-

minal chamber, and the boats can there be floated directly in. The details appear to be well worked out, and the estimated time of the operation of lifting is placed at 24 minutes for a single lift, of which eight minutes only are required for the actual lift, the remainder being required for the terminal building.

The authors of this ingenious design are engineers August Umlauf and Ludwig Ritter v. Stockert, of Vienna; Baurat C. Offerman, of Berlin; the Austrian Siemens-Schuckert Works, of Vienna; the Andritz Machine Works; and the United Augsburg and Nürnberg Machine Works.

These two projects are of much interest, both as indicating the extent to which plans have gone in producing substitutes for the ordinary canal lock, and also because neither of the prize designs are of the hydraulic-plunger lift type hitherto adopted for such work. Whether either design will ever be actually executed will probably depend upon other matters connected with the construction of the Danube-Oder canal, but both are most suggestive, and may serve as models for use elsewhere.

HOISTING PROBLEMS IN MINING.

MACHINERY AND METHODS OF RAISING ORE FROM THE DEEP SHAFTS OF THE LAKE SUPERIOR MINING REGION.

James R. Thompson—Lake Superior Mining Institute.

SEVERAL months ago we reviewed in these pages the paper by Mr. Hans C. Behr upon winding plants for deep mines, this paper having been presented before both the Institution of Mining and Metallurgy in London and the South African Association of Engineers at Johannesburg, and receiving an animated discussion in both places. This paper naturally dealt mainly with the problems to be met in South Africa, and it finds a fitting supplement in a paper presented before the Lake Superior Mining Institute by Mr. James R. Thompson, since this latter deals with the practice of the mining region about the Great Lakes of America.

Starting with the fundamental principle that the direct productive work of a mine is done underground, it follows that the arrangement of all other details should be based upon their influence upon underground efficiency. Viewed in this manner, it follows that in hoisting the speed is of first importance.

"Hoisting practice on Lake Superior largely, but perhaps unconsciously, conforms to a certain standard of speed. This standard may be stated as follows: No matter what the depth, the load must be hoisted from the bottom of the mine within one minute, and the round trip must take not more than two and one-half to three minutes. This seems arbitrary enough, but the fact is, that the second-motion hoists installed at the iron mines of from 300 to 800 ft. depth have roughly conformed to it no less than the big Nordberg quadruple engine at the Tamarack, with its 25½-ft. drum, hoisting from approximately 5,000 ft., and making from 18 to 20 trips per hour. A duplicate of this hoist is now being installed, a fact which speaks for itself. It is on record that a hoist at the De Beers mine, at Kimberley, has made 46 round trips in one hour per single skip, and has maintained an average of 32 round trips per hour for 24 hours from a depth of 1,260 ft. A first-motion hoist, with 12-ft. drums, installed some fifteen years ago at an iron mine about 500 ft. deep, could undoubtedly, if it actually did not, exceed that record. That such a speed of hoisting is unnecessary and excessive is indicated by the fact that a plant recently installed at the same iron mine, to meet the same conditions, has drums but six feet in diameter instead of twelve. Coal mines, which usually screen their product at the top of the shaft, are apt to serve a large territory by one shaft, and with lighter loads hoist more rapidly, often reaching the rate of a round trip per minute from a depth of 500 or 600 ft. It might be expected that the large iron mines, especially as they gain depth, would reduce the number of operating shafts and require a more rapid rate of hoisting; however, observation of the shafts projected, and the hoisting fa-

cilities planned, leads to the conclusion that the rate of hoisting quoted will suffice to dispose of the required production."

The question of speed hoisting is not necessarily limited to the lineal speed of travel, since it really means the speed of transport of material to the surface, and this is dependent upon the size of load as well as upon the rapidity of its movement. In the early days of shallow mines a single ton was considered a fair load, while now the loads are 5 tons in the iron mines and 7½ tons in the copper district. In general the requirements are that the load must be hoisted in one minute and a round trip made in three minutes, regardless of the magnitude of the load.

Such conditions as these are naturally severe upon both winding machinery and power plant. The tendency in the latter department is toward an increase in steam pressure, 150 pounds being now used as compared with 100 pounds formerly. In like manner it is being found better to attain high winding speeds by the use of smaller drums at higher rotative speeds, than to employ the large drums, since the quick running enables smaller, lighter engines to develop the same amount of power, effecting a material reduction in first cost. So far as the question of steam economy is concerned, however, altogether different elements are to be considered than in the case of a stationary power plant.

"Where steady power is required, the advisability of installing compound-condensing or triple-expansion-condensing engines is unquestioned. The duty required of a hoisting plant, however, is peculiar, and the ordinary treatment does not necessarily fit the case. The load upon a hoisting engine consists of the weight of the ore, which is the total live load, the weight of the cage, car or skip, which is a constant dead load, and the weight of the rope, an important percentage of the whole, which is a dead load continually varying in amount, being greatest at the beginning of the trip and nothing at the end. Added to this variable and largely unprofitable loading of the engines is the extremely intermittent character of the service required. The engines must start the maximum load, attain full speed in six or seven revolutions, hoist a continually decreasing load to the surface and stop short—all within one minute, and after a longer or shorter period of idleness, they must repeat the operation. Under such conditions the ordinary methods of obtaining economy of operation in steam-engine practice are insufficient, if not positively worthless. Lake Superior experience has fully demonstrated that a simple Corliss or other automatic variable cut-off gives more economical results than a slide valve or fixed cut-off, and engines of such design have been adopted at deep mines. The results of the attempt to gain a still greater economy of operation by the use of compound or triple-expansion engines are indefinite, if not negative. The subject is one of practical difficulty, for the reason that no one knows definitely what steam is required by the various types of engines in actual hoisting service. Even the compound and triple engines must use steam non-expansively to start and rapidly accelerate the load, and as different plants, and, indeed, the same plant at different times, are handling loads which vary greatly in the proportion between the live and dead loads, it is impossible to estimate the steam consumption in the ordinary method. The boilers supplying steam for hoisting usually also supply steam for pumping, air-compressing and other purposes, which renders it impossible to determine directly just the amount of coal to be charged to the hoisting. Even if this could be done, two plants are rarely to be found working under conditions sufficiently alike to render an accurate and reliable comparison possible."

In this connection it is interesting to note that it is to just such conditions as these that the Rateau steam accumulator has been applied with success, the irregular flow of steam from the main engines being equalized by the accumulator, and a large proportion of the power recovered by means of a low-pressure steam turbine. This method has shown its practicability in France, and its application is at once simpler and more satisfactory than any attempt to use a multiple-expansion engine under conditions for which it is unsuited.

In regard to the operation of hoisting itself, the principal question is that of balancing. With deep hoists the weight of the rope is an important element frequent-

ly equalling that of the useful load to be hoisted. The cars and cages are also included in the dead load, but these are constant, and in the case of a double hoist the two cages and their dead loads balance each other. The weight of the rope, however, is variable, and ranges from a maximum when the cage is at the bottom, to zero when it is at the top. The most complete balance is obtained by attaching a balance rope to the bottoms of the skips, extending from one skip to the other around a pulley placed at the bottom of the shaft.

"From the standpoint of the purchaser, the following conclusions may be drawn as to the requirements to be met by an ideal modern hoisting plant. It should use at least 150 lb. of steam pressure, because of the smaller size and cost of engines then required, and the fuel economy resulting. It should hoist the load from the bottom in one minute, and make a round trip in less than three minutes, no matter what the load or depth of shaft. The net load should be as large as possible in proportion to the dead load, and the mass of moving machinery should be kept as small as possible. The most perfect plan of balancing feasible under the individual circumstances should be used. A plain Corliss or other automatic, variable cut-off engine is best, and it is desirable to use engines of as high rotative speed as is found practicable in other lines of engine practice. The drums should be as small as possible for the required hoisting speed and capacity, when driven by high-speed engines. Straight drums should be used, as there is no advantage to be gained by special designs of cone-drums, rope-reels or other hoisting systems, sometimes advocated, over straight-drum designs, with the drums made as small as they may be made by using engines of high rotative speed to drive them."

SHOP TESTING OF MATERIALS.

THE DETERMINATION OF THE QUALITY OF A METAL BY ITS RESISTANCE TO THE OPERATION OF PUNCHING.

L. Baclé—Société d'Encouragement pour l'Industrie Nationale.

IN determining the quality of a metal for purposes of construction it is usually considered desirable to subject certain test pieces to determinate stresses in suitable machines, constructed expressly for the purpose, and this plan should be adopted, and the results recorded, in all important work. At the same time it is possible to learn much about the character and quality of a material simply by observing its behaviour under the various machining operations to which it is subjected in the course of manufacture, and this plan possesses some advantages. Thus it is not always certain that the piece selected for the examination in the testing machine fairly represents the actual portion which is to be included in the completed structure, besides which it is necessary that all the conditions under which the testing is done should be known in order to enable the results to be used with confidence. If, however, the resistance offered by the actual piece under consideration can be measured, without requiring any special testing, the engineer is placed in possession of a method of great utility and extended application.

In a paper recently presented before the *Société d'Encouragement pour l'Industrie Nationale* by M. Baclé, himself well known as an expert in the department of engineering work including the testing of materials, the use of the process of punching is considered in connection with the determination of the quality of the metal under manipulation, and some abstract of his discussion will be found of interest and value.

As long ago as 1836 the first direct-acting steam punching machine was made by Cavé and Lemaître, and they soon noticed the marked difference in resistance to punching offered by forged pieces compared with those of puddled metal, and from these observations the use of punching as a method of testing may be dated. The machine used by these experimenters included two fly-wheels fixed directly upon the engine crank shaft, and these, having but a low velocity stored up but a mod-

erate amount of energy. As a result of this arrangement there was an appreciable reduction in velocity due to the resistance of the metal to the punch, and it was altogether possible to perceive, by the extent of the reduction in velocity, the relative resistances of various materials. Of course, such a method gave only the most general indications, but it has shown the applicability of the operation to more refined and precise determinations.

About ten years ago M. Frémont devised a so-called elasticimeter, a device indicating the effort involved in punching by measuring the elastic flexure of the machine in which the work was done. In this method the yield of the frame of the punching press was caused to operate a recording device which enabled the punching force to be determined by inspection, thus converting the operation into a quantitative one. M. Baclé has further improved upon this for his own purpose of research by constructing a special punching machine, made intentionally with a deep throat and constructed of steel, thus giving a larger degree of elastic yield than would ordinarily be the case. By operating the machine by hand it has been found possible to stop the operation of punching at any point, and in this way the resistance of the material at different depths of penetration have been determined. A comparison of the results thus obtained with those found by tension and shearing tests on the same material has enabled the relation of the punching resistance to the tensile and shearing strength to be found, and these comparative relations have been reduced to formulas and plotted as diagrams by M. Baclé.

It appears that the maximum resistance to the operation of punching bears a direct relation to the tensile strength of the metal, so that the latter may be determined by the observation of the former, and if, as is usually the case, a number of holes are to be punched in the metal, a far more general average will be obtained than could be possible from a few tension tests. It is not to be expected that the method will give results of such a high degree of precision as are possible with the refined apparatus of the testing laboratory, but a thoroughly practical knowledge of the operative resistance of the material may be obtained, without interfering at all with the progress of the work through the shop. M. Baclé has plotted results upon materials ranging in tensile strength from 30 to 75 kilogrammes per square millimetre (42,670 to 106,675 pounds per square inch) and shows that within these limits the method presents results well within the degree of precision demanded in practical work.

So far as the question of elongation is concerned, M. Baclé admits that the punching method permits results of but partial value to be obtained. The ductility of the metal is fairly well shown by the behaviour during punching, but it must be remembered that the total elongation shown in tension tests includes two distinct elements which it is not always easy to separate. One of these elements is the elongation corresponding to the reduction in sectional area, or, as M. Baclé calls it, the elongation of striction, while the other is the elongation due to the actual yielding of the material, distributed over the whole area. These two are almost invariably added together and considered as to total elongation. Since the real reduction in area is not easy to measure, especially in pieces of irregular section, it is common to consider only the total elongation, and the conclusions drawn from such data may be very misleading, even in the case of tension tests otherwise accurate and reliable. In the case of punching tests, however, it is possible to draw very useful conclusions as to the ductility of the material from the form of the diagram.

It is evident that the use of punching as a method of testing has many advantages, and intelligently used it enables the quality of the material under manipulation to be controlled within practical limits. It is not intended to be used as a substitute for the more precise methods of the testing laboratory, but rather as an auxiliary, and when so used it may be made a valuable aid to the production of reliable work.

The use of the elasticity of the frame of a machine tool or testing machine as a means of securing a record of stresses is not new, but it is an entirely practical method which is undoubtedly capable of further useful application.

THE UTILISATION OF TIDAL POWER.

PRACTICAL METHODS OF OBTAINING MOTIVE POWER FROM THE RISE AND FALL OF THE TIDES.

The Engineer.

THE question of utilisation of tidal power is a problem which has attracted attention at various times, and numerous plans have been devised for its solution. Some of these have been entirely practical, such as the small tide mills occasionally found on streams within the tidal reach along the coast, but these are little more than toys. Many great schemes have been planned by amateurs, but have never passed the paper stage, and as a matter of fact little or nothing has really been done in a practical way on a scale of any magnitude.

The general subject of tidal power schemes is discussed in recent issues of the *Engineer*, and the practical nature of the treatment renders it well adapted for a presentation of correct ideas on a matter concerning which some extravagant views are often held.

"To a casual observer it might appear that a great deal of power is daily exerted by the tidal forces in raising ships and other objects floating on the surface of the sea from low-water to high-water level. The work done is, however, relatively small, as recourse to figures readily proves.

"Let us take, as an example, H. M. S. Kent, afloat at a place where the range of tide is 15 ft. By referring to the Navy List we find the displacement of this ship to be 9,800 tons. Assuming the rise of the tide to take place in six hours, the average horse-power exerted upon the ship is—

$$\frac{9{,}800 \times 2{,}240 \times 15}{33{,}000 \times 6 \times 60} = 27\tfrac{3}{4} \text{ nearly,}$$

quite an insignificant amount when we observe that the indicated horse-power of the engines is given as 22,000.

Apart from any questions of cost, one of the difficulties connected with the operation of entrapped water in high-tide basins, is found in the irregular character of the power development. This is partially obviated in the system of M. Decoeur, proposed for application in France. Instead of using a single high-tide basin, this plan employs two basins, the water level in one, the high-water basin, ranging from high water to, say, one-third of the tidal range below high water, and the water level in the other, the low-water basin, from one-third of the tidal range above low water to low water. The flow through the turbines takes place from the high-water basin to the low-water basin, the two basins receiving and discharging from and to the sea. The two basins are fitted with automatic gates, the flow from the sea into the high-water basin taking place as soon as the tide outside rises above the water level inside, while the converse occurs in the low-water basin, the gates opening outwards as soon as the outside water level falls below the inside. Elaborate plans were made for the development of this system on the banks of the Seine at Havre, but these were never executed, probably because of the possible injury to the port of Havre by the works.

Apart from any difficulties connected with the irregularity of the motive power, the cost of installation plays an important part in any system of tidal power generation including the use of entrapping reservoirs. Such works are necessarily to be located at points where there is a reasonable demand for power, and where, in consequence, the value of the land and water rights are high. If the plan can be made to include natural basins, such as are found in some tidal estuaries, this cost may be kept within reasonable limits, and it may then be possible to secure power and a moderate charge including a reasonable allowance for interest and depreciation.

"In considering the economy of a tidal power scheme, the extremely high efficiency of all water motors as compared with other classes of engines must not be overlooked. Steam engines rarely give more than 12 per cent., and gas engines 20 per cent., of the energy due to the combustion of the fuel. Some of the best turbines give 80 per cent. or more of the theoretical power, at full gate.

"Not only is a due consideration of the

natural adaptability of the coast line to the construction, at a moderate cost, of enclosing dams necessary to the inauguration of a successful tidal power scheme, but the range of tide at the place selected is an element of the highest importance.

"The variation of range from springs to neaps is a difficulty which requires considerable ingenuity to meet satisfactorily, but the diurnal inequality which amounts, for example, at Bombay, to 6 ft., is practically non-existent in the United Kingdom. The tidal range in estuaries is greater than that on the open coast.

"Turning now to an entirely different aspect of the question, we find that the lot of a worker in our tidal factory would not be a very happy one at least until he had become accustomed to the novel conditions of labour to which he would be subjected. The working hourse would be regulated by lunar not by solar time. Assuming that the turbine installation gives eighteen solar hours' work per solar day of twenty-four hours, it would be necessary to have two shifts each working nine hours. If the establishment of the port were four hours at full and change of moon, one gang would begin work about seven solar hours after the moon had crossed the meridian either in the zenith or nadir; that is, about one hour after moonset or one hour after moonrise. Therefore, at spring tides one gang would work the greater part of the day and the other the greater part of the night. The second gang would have the benefit of brilliant moonshine when the moon would be in opposition, or no moon when in conjunction. If these conditions of work were stable there would be little to complain of. The night workers might receive additional pay to compensate them for the disadvantage of night work. But, owing to the lunar day being fifty minutes longer than the solar, the working hours would be continually changing with respect to the sun.

"In the way of good works management much might be done to reduce to a minimum the loss consequent on fluctuations of power. The heavier classes of work might be done at spring tides; and at neaps machines for the finer processes might be brought into play. Much of the surplus power might be used for the electro-deposition of silver and other metals. Indeed, few industries lend themselves more naturally to this form of motive power than electro-plating. The quantity of metal deposited is directly proportional to the quantity of current used. Current for this purpose might be granted at a lower rate at springs. At neaps all hands might be employed in polishing and preparatory processes. The grinding of corn and of the materials in the manufacture of cement, the crushing of ores, the electrolysis of water and of chemical salts, the crushing and hackling of jute and flax—all these, and doubtless many of the heavier operations in other industries, might be economically carried on at the lowest rates possible at springs. But if in practice such arrangements were found impracticable or costly, then by the extension of the high-level reservoir system the supply of power might be made absolutely constant."

WATER-POWER FOR ELECTRIC TRACTION.

THE UTILIZATION OF THE HYDRAULIC POWER OF THE PACIFIC COAST FOR THE ELECTRICAL OPERATION OF RAILROADS.

Robert McF. Doble—Pacific Coast Railway Club.

WE have referred elsewhere in this issue to the problems connected with the introduction of electric traction on main-line railroads, but in the great majority of cases it must be assumed that the original source of power will be a steam driven central generating station, and it is on this assumption that the computations are generally made in comparing electric traction with steam locomotives. In a paper presented before the Pacific Coast Railway Club Mr. Robert McF Doble calls attention to the adaptability of water power in certain localities.

The advantages of electric over steam traction may be considered under three heads: those appealing to the passenger, and resulting in an increase in traffic; those pertaining to the centralization of power; and those relating to economies in

first cost, and maintenance and operating expenses. Under the first head may be included the freedom from dirt and smoke, and the general cleanliness and the better ventilation and lighting of the cars. These, however, are possessed by electric traction regardless of the source of motive power, and hence have no especial applicability to the question of hydraulic power. The matter of power centralization, however, is a different matter. The steam station has many limitations, and it is a matter of interest to note that these limitations are most marked in localities where hydraulic power is most available. Thus the development of electric traction in Switzerland and in Northern Italy has been most apparent in connection with the fact that both of these countries, while possessing no coal, have ample sources of water power capable of development in the Alps and available for transmission to the adjacent valleys and plains.

The same is true on the Pacific coast, where available water powers are distributed at frequent intervals all the way from Southern California up to British Columbia. But a small portion of this power has as yet been developed, but enough has already been done to show the possibilities of the country. The stations now in operation, and the success which had been had with long-distance transmission from the mountains to the coast, indicate that the operation of railroads by hydraulic power and electric transmission should be a profitable matter. It is entirely possible to arrange the location of hydro-electric stations so as to permit several power plants to feed into one distributing network, each supplementing the power of the other, and precluding the possibility of any general interruption. Since the capacity of the steam locomotive has to be that of the maximum effort required, even though that effort be for a very short time, there is a distinct advantage in the electrical system, in which the load on the power station is only the sum of the loads on the different motors, averaging much less than the sum of their maximum powers.

The application of electric traction in California affords especial opportunity for the development of those systems in which the recovering of the energy required for braking is included, this plan having already been developed in Europe, as on the new Jungfrau line, and elsewhere. The power developed by the trains on the descending mountain divisions, frequently occurring in California, may thus be utilized in connection with electric traction, while wholly lost when steam locomotives are employed.

Turning to the achievements of electric traction in California, Mr. Doble made particular reference to the Los Angeles and Rodondo Railway, the Pacific Electric Railway of Los Angeles, and the North Shore and Key Route systems of San Francisco. The North Shore Railroad is of special interest by reason of its being the first and only third-rail line in California and because of its being operated from a sub-station which is the terminus of one of the longest transmission lines in the country. The Alto station referred to is 180 miles from the hydro-electric plant at Colgate and 250 miles from the new De Sabla power house. One of the features of the Key Route system is the diamond trolley, which is successfully used on all of its trains.

As to projected electric lines on the Pacific Coast, Mr. Doble referred to improvements which the Southern Pacific Company has under consideration for its suburban lines in Oakland, Berkeley and Alameda, to the rumored electrification of that company's San Jose and Port Costa lines and also to the possibility of operating its mountainous divisions by electricity. Mr. Doble concluded with some very interesting remarks on the leading hydro-electric power stations and transmission systems of California. The distinguishing characteristics of each plant were mentioned and special reference was made to the new De Sabla power house of the California Gas & Electric Corporation, where is now operating an 8,000 horse power tangential water wheel, said to be the largest single water wheel ever constructed. This station regularly supplies power to San Francisco and other points over 300 miles distant.

It is believed that this plant includes the longest electric-power transmission which has yet been operated, although it is probable that the limit has by no means been attained.

REFUSE DESTRUCTOR STATIONS.

THE COMBINATION OF DUST DESTRUCTORS AND ELECTRICITY WORKS ECONOMICALLY CONSIDERED.

W. P. Adams—Institution of Electrical Engineers.

IT is now generally conceded that the best way to dispose of organic refuse is by fire, but notwithstanding the improvements which have been made, and the continual efforts directed toward the complete solution of the problem there yet remains much to be done before entire satisfaction can be said to have been attained. In a paper presented before the Institution of Electrical Engineers by Mr. W. P. Adams some of the latest work which has been done in this direction is described, and the paper together with the discussion which it elicited demands attention and review.

A large portion of Mr. Adams's paper relates to descriptions of the construction and performance of well-known types of destructors in various localities, and for these the reader must be referred to the original paper. He also gives some general principles, however, which may well be repeated here as forming an excellent guide to designers of such plants.

"The points in common with all modern high-temperature destructors are, forced draught, preferably heated, means of drying the refuse in part before placing on the grate, and a combustion chamber in which all gases are mixed and brought to a state of high incandescence and their temperature equalized so far as possible.

"Steam blast for producing forced draught is claimed to have advantages over simple air blast in that it produces water gas in passing through the incandescent fuel, which materially aids combustion; it also tends to keep the fire bars cool, thus giving them an appreciably longer life and clinkering is rendered easier. It is an extremely difficult matter to measure the steam blast, except on specially arranged tests, but it is a very simple matter to measure the power used by electrically driven fans. However, it is a question that does not turn entirely on the relative consumption of power, as the improved combustion with fuel of high calorific value may outweigh the extra percentage of steam used with steam blast. This is one of the interesting points upon which additional information would be of value, but it will be a hard matter to justify the application in the blast of twenty to forty per cent. of the total steam generated. Economy in the blast is of considerable importance, as the absorption of power is continuous, and if a wasteful form be used a large percentage of its power available is wholly lost.

"The prevention of air leakage is another important matter, and long and badly arranged flues are also a prolific source of lost power. A principle never to be lost sight of in the construction of destructors is, that after the perfect cremation of the refuse has been secured, the heated gases should be applied directly to the boiler without having to pass through long flues. Again, the charging arrangements are sometimes crude and not designed or constructed with a full appreciation of the problem involved; the furnaces of the boilers are often a source of trouble through air leakage and unsatisfactory combustion effects, and not a few combined works show poor results through careless and indifferent handling of the refuse and management of the burning.

"The composition of refuse varies largely in different parts of the country; in the neighborhood of coal mines it is often rich in carbon. In towns having a staple industry, where much waste material from the factories is sent to the destructor, the calorific value of the refuse may be high or low, according to the carbon in such waste material. Suburban residents generally provide quantities of garden stuff to feed the destructor, and although the percentage of carbon in this stuff is large, so also is the percentage of moisture, and it is therefore not regarded with favor by destructor managers."

It is a matter of interest to note that the richest refuse often comes from the poorest localities, while from the wealthies districts near by the material is of only an average quality. This is attributed to the greater wastefulness of the working classes,

and however this may be, the fact appears to be well substantiated.

"Some of the difficulties to be met with in the utilization of refuse-raised steam for electrical purposes are—uncertain delivery of the refuse, the varying value of the refuse from day to day and hour to hour, and the varying percentage of moisture contained; also in winter snow may prevent collection for many days, fog sometimes greatly hampers collection, and holidays occasionally prevent collection for days. By careful management and forethought some of these difficulties may be largely neutralized, but it is merely sufficient to call attention to them to demonstrate that only under favorable conditions may a combined plant be expected to run for any length of time on refuse alone.

"To equalize to some extent the varying quantities collected, and also to adapt the quantity burnt to the varying demand for electricity, some system of storage is desirable; this is especially so where the electricity works has a small day load. The refuse itself may be stored and burnt as the demand requires, or, when direct-current plant is used, a battery may be employed with advantage. A large destructor plant is best run seadily throughout the twenty-four hours, and no great difference in the rate of burning during the day and on the peak is admissible. With a twelve-cell plant, eight cells might be run during the day and twelve at night. This represents a maximum variation, and it will, therefore, be seen that where the day load is small, a peak load some five times greater could not be coped with in this manner. These batteries are to be strongly advocated for they not only serve for storage during the day, but with a suitably arranged reversible booster they equalize the load when the steam generation varies, as it does very rapidly sometimes. To secure the best results such a battery need not be abnormally large. A combined station burning some 30,000 tons per annum would require a battery of about 1,000 to 1,500-kilowatt-hour capacity, assuming a simple lighting load with a day demand about one-fifth of the peak load."

In view of the fact that a destructor station is primarily intended for the destruction of refuse, and only secondarily as an electrical generating plant several points must be considered.

At first it is probable that ample heat will be furnished for the demand for electricity supply for the district. The demand for current, however, is apt to increase faster than the supply of refuse, so that provision must be made, either for increase with coal fired boilers, or by the erection of an auxiliary generating station.

Again, the destructor station must be located where it will be as unobjectionable as possible, and this may render it inconvenient as an electricity supply source. These points may well be met if considered in the beginning, but may otherwise become troublesome later. In every event, however, it must be remembered that the complete and inoffensive combustion of the refuse is the main end to be accomplished, and that the power generated should be considered only after this has been successfully accomplished.

STRESSES ON HYDRAULIC MAINS.

A STUDY OF THE CAUSES OF DEFORMATION OF LARGE HYDRAULIC CONDUITS FOR POWER PLANTS.

C. Birault—Société des Ingénieurs Civils de France.

THE ordinary practice in the computation of the strength of mains for conveying water has been to use dimensions sufficient to resist the internal pressure, and in most instances this gives ample strength for all purposes. With the development of hydraulic power plants, in which large sheet-metal pipes are used to convey water from distant and elevated sources to the lower level of the power station, it has become common to lay the mains directly upon the surface of the ground, and under such conditions the deforming stresses, due to the weight of the pipe itself as well as the contained water, should be taken into account. A paper presented before the Société des Ingénieurs Civils de France by M. C. Birault, and

published in the *Mémoires* of the society, examines the causes acting to produce flexure of the walls of such conduits, and some brief abstract of his discussion is of interest.

M. Birault considers especially the practice in France, where the development of the "white coal" in the Alps has already resulted in the utilization of about 150,000 horse power, and where new projects are continually being considered. The sheet metal mains, of moderate thickness and large diameter, used for the conveyance of the melting snow to the power houses in the valleys, are here found to need special attention to enable them to resist the forces tending to cause them to flatten, or become oval, even under their own weight, apart from the load of the contained water. This is especially the case when conduits as large as 2.50 to 3 metres in diameter are employed, these sometimes being made of mild steel, with walls as light as 6 to 7 millimetres at the origin, where the internal pressure is light.

An example of the experience gained in France is found in the main constructed in the Isère district for the Clavaux Works, in which a main 2.5 metres in diameter, for a head of 42 metres, and a total length of 1,000 metres, was made 6.5 mm. thick at the origin, and 13.5 mm. thick at the lower portion. This conduit was to be supported on masonry piers, but it was found, on erection, that the piers penetrated into the main, so that it was necessary to reinforce the latter with ribs of channel bars to secure sufficient rigidity, although the thickness was ample to resist the internal pressure.

The best method of supporting such mains is undoubtedly the employment of a semi-circular cradle or foundation in the ground for the entire length, but this arrangement is not always possible. In other cases masonry supports, with cradles of structural metal, may be used, and if these are sufficiently close together no further reinforcement is necessary, otherwise longitudinal ribs of angle of channel iron should also be added.

For the higher portions of such mains the construction may be of reinforced concrete, the thickness of the concrete giving ample stiffness to resist circumferential deformation, although this method should be supplemented by longitudinal supports when the conduits are carried on widely spaced piers. The thickness of the lower levels of a high pressure main, necessary to resist the internal pressure, generally gives enough stiffness to prevent deformation, and the principal care is required in connection with the upper portion, where a thin pipe is sufficient if properly braced against deflection.

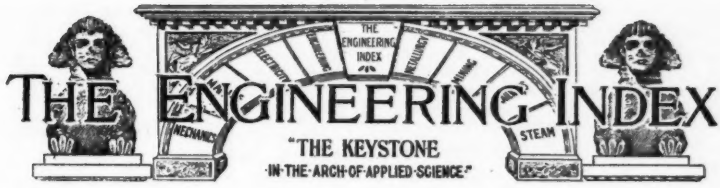
M. Birault gives a mathematical treatment of the stresses upon such conduits under various conditions, plotting curves showing the changing stresses during the filling of the main with water, as well as the influence of different supports.

Whenever possible, mains of large diameter should be given continuous support, or if piers are necessary they should be placed sufficiently close together to render the longitudinal stresses and consequent flexure negligible. If the local conditions compel the use of widely spaced piers, there should be a double system of longitudinal and transverse bracing, computed according to the formulas deduced for the span and the diameter of the main.

Pipes of moderate diameter are generally thick enough to resist flexure, even when supported on isolated piers, and the stresses in such cases may be computed in the same manner as for ordinary beams.

M. Birault calls especial attention to the desirability of placing the longitudinal riveted seams so that they will not be subjected to longitudinal deflection, this being entirely possible if the moments of flexure are studied according to the conditions of support of the respective portions of the main.

The principal point to be emphasised is the necessity, in the design and erection of mains of large diameter, of taking all the stresses into account, and, instead of merely making a pipe of the required diameter, sufficiently thick to resist the internal pressure, such a main should be designed, under competent engineering supervision, for the especial location for which it is intended, with full knowledge of the manner in which it is to be supported, and it should be erected in the precise manner in which it was intended by the engineer by whom it was designed.



The following pages form a DESCRIPTIVE index to the important articles of permanent value published currently in about two hundred of the leading engineering journals of the world—in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index note gives the following essential information about every article.

(1) The full title,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published.

We supply the articles themselves, if desired.

The Index is conveniently classified into the larger division of engineering science, to the end that the busy engineer and works manager may quickly turn to what concerns himself and his special branches of work. By this means it is possible within a few minutes' time each month to learn promptly of every important article, published anywhere in the world, upon the subjects claiming one's special interest.

The full text of any article referred to in the Index, together with all illustrations, can usually be supplied by us. See the "Explanatory Note" at the end, where also the full titles of the journals indexed are given.

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CIVIL ENGINEERING

BRIDGES.

Arches.

A Statical Examination of Flat Arches (Zur Statischen Untersuchung von Flachen Gewölben). Dr. Josef Schreier. A mathematical treatment developing formulas for use in designing masonry arches of small size in proportion to span. 5000 w. Zeitschr d Oesterr Ing u Arch Ver—Jan. 6, 1905. No. 67335 D.

The Stone Bridge at Hartford, Conn. Illustrating and describing a masonry highway bridge of eight semi-elliptical arches with spans of 68 to 119 feet, now under construction. 4000 w. Eng Rec—Dec. 31, 1904. No. 66959.

Drawbridges.

An Electrically Operated Highway Drawbridge for Small Waterways. H. G. Tyrrell. Plan and description of a design prepared for a bridge to cross the Miami and Erie Canal at New Bremen, Ohio. 900 w. Elec Rev, N. Y.—Dec. 31, 1904. No. 66983.

The New Newark Bay Bridge. S. D. V. Burr. Illustrates and describes the tandem Scherzer rolling lift bridges on the Central Railroad of New Jersey. 800 w. Ir Age—Jan. 5, 1905. No. 67007.

We supply copies of these articles. See page 1038.

Erection.

A Difficult Piece of Bridge Erection in Connection with Terminal Improvements of the New York Central & Hudson River R. R. Co. Frank C. Shepherd. An illustrated description of the peculiar conditions and the methods employed. 1200 w. Eng News—Jan. 5, 1905. No. 67044.

Failure.

The Charleston Bridge Failure. H. G. Tyrrell. An illustrated account of the failure of a suspension bridge at Charleston, W. Va., and an explanation of the cause. 900 w. Eng News—Jan. 5, 1905. No. 67047.

The Charleston Bridge Failure. Illustrations of the present condition of the wrecked bridge, with information concerning the cause, and editorial comment. 2000 w. Eng Rec—Dec. 31, 1904. No. 66963.

Hinges.

Experiments with Sandstone Blocks for the Hinge Joints of Arches (Versuche mit Sandsteinquadern zu Brückengelenken). C. Bach. Experimental researches upon the crushing of sandstone rocker-hinge blocks as used in masonry arches, with diagrams for arches of various radii. 1200 w. Zeitschr d Ver Deutscher Ing—Dec. 17, 1904. No. 67301 D.

Plate-Girder.

A 100-Foot Plate-Girder Span with Unusual Bearings. Illustrated description of the new 100-ft. span at Ship Pond Stream, Me. 1500 w. Eng Rec—Jan. 14, 1905. No. 67178.

The Bethlehem Junction Bridge. Illustration, with description, of a single-track plate-girder bridge with a clear span of 80 feet, carrying the C. R. R. of N. J. over the Lehigh Canal, recently built to replace an old skew-bridge. 2000 w. Eng Rec—Jan. 21, 1905. No. 67404.

Reconstruction.

Rebuilding the Big Four Bridge at Terre Haute. Illustrates and describes changes being made in a bridge over the Wabash River. Three Pratt truss spans, too light for present loading, are being replaced with two 184-ft. spans. 700 w. R R Gaz—Vol. XXXVIII, No. 4. No. 67491.

The Reconstruction of the Point Bridge, Pittsburg, Pa. Willis Whited. An illustrated article describing the condition of the old structure, the repairs that were made, and the manner of executing the work. 4800 w. Eng News—Jan. 26, 1905. No. 67479.

Reinforced Concrete.

Reinforced-Concrete Girder Bridge at Bamberg (Balkenbrücke in Eisenbeton in Bamberg). Description of the construction and erection of highway girder bridge of 21 metres span. 1200 w. Deutsche Bauzeitung—Jan. 11, 1905. No. 67398 B.

See also Civil Engineering, Construction.

Skew-Arch.

A Skew-Arch of Concrete Steel. Drawings and description of details of a bridge over St. Joseph River, in South Bend, Ind. 800 w. Munic Engng—Jan., 1905. No. 67219 C.

Substructure.

The Substructure of the Cambridge Bridge, Boston. Describes the substructure of a bridge over the Charles River, which is to carry an important city street, and has been designed with a view to harmony with the surroundings. 3400 w. Eng Rec—Jan. 14, 1905. No. 67179.

Transfer-Bridge.

The Nantes Transfer-Bridge. Illustrates and describes a bridge recently built over the Loire differing in many ways from the usual designs. 1200 w. Engng—Jan. 13, 1905. No. 67450 A.

Viaduct.

A Boulevard Supported on Cantilevers. Brief illustrated description of a cantilever platform to be erected to carry Riverside Drive over the railroad tracks in New York City. 800 w. Eng Rec—Jan. 28, 1905. No. 67520.

Wind Pressure.

Probable Wind Pressure Involved in the Wreck by the High Bridge Over the Mississippi River on Smith Avenue, St. Paul, Minn., Aug. 20, 1904. Discussion of the paper by C. A. P. Turner. 1800 w. Pro Am Soc of Civ Engrs—Dec., 1904. No. 66970 E.

CONSTRUCTION.

Balcony.

The Computations for a Half-Ring Balcony (Berechnung Halbringforiger Balkontrager). Dr. Leopold Pfeffer. A graphical and analytical examination of the stresses in a projecting balcony of semi-circular or semi-elliptical form. 5000 w. 1 plate. Oesterr Wochenschr f d Oeffent Baudienst—Nov. 26, 1904. No. 67379 D.

Boulders.

Methods and Cost of Blasting and Handling Boulders. Daniel J. Hauer. Explains the different methods of handling and breaking up both large and small boulders, giving some data as to the cost. 6500 w. Eng News—Jan. 5, 1905. No. 67045.

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Building Construction.

Structural Features in the Phipps Power Building, Pittsburg, Pa. Edward Godfrey. Brief illustrated description of the structural steel works. 1300 w. Pro Engrs Soc of W Penn—Nov., 1904. No. 67241 D.

The Structural Design of Buildings. Continued discussion of paper by C. C. Schneider. 6000 w. Pro Am Soc of Civ Engrs—Dec., 1904. No. 66971 E.

The Structural Design of Buildings. Continued discussion of paper on this subject by C. C. Schneider. 7000 w. Pro Am Soc of Civ Engrs—Jan., 1905. No. 67503 E.

Dams.

Essential Elements in the Design of Dams. John S. Fielding. Considers matters pertaining to these structures, their stability, economy, etc. 2200 w. Can Engr Jan., 1905. Serial. 1st part. No. 67149.

Rolling Dams at Schweinfurt, Bavaria. Emile Guarini. Illustrated description of interesting movable dams and their working. 7000 w. Eng News—Jan. 19, 1905. No. 67284.

The Charles River Dam and Basin at Boston and Cambridge, Mass. J. Albert Holmes. Treats principally of the foundations of the lock and sluices and the proposed shut-off dam. Ills. 2500 w. Eng News—Jan. 12, 1905. No. 67154.

The Roosevelt Masonry Dam, on Salt River, Arizona. Description of a high masonry dam, which is to form a reservoir of 320,000,000,000 gallons capacity. Ills. 2500 w. Eng News—Jan. 12, 1905. No. 67156.

Docks.

See Civil Engineering, Waterways and Harbors.

Ferry-House.

The New Steel Ferry-House of the Central R. R. of New Jersey. Illustrates and describes the new ferry-house at the west end of 22d st. in New York. 3000 w. Eng Rec—Jan. 7, 1905. No. 67070.

Frameworks.

A Graphical Examination of the Stresses in Framework Struts (Graphische Ermittlung der Einflusslinien für die Stabspannungen in Ständerfachwerk). S. K. Drach. A special graphical method for members subjected to thrust. 3000 w. Zeitschr d Oesterr Ing u Arch Ver—Dec. 30, 1904. No. 67334 D.

A Steel-Frame Riding Academy Building. Brief illustrated description of a building recently erected at Scituate, Mass. 800 w. Eng Rec—Dec. 31, 1904. No. 66964.

The Influence of Horizontal Forces upon Framed Structures (Einflusslinien für die Beanspruchung Gerader Fachwerkträger durch Horizontale Kräfte). Wenzel St. Ritter v. Balicki. A graphical investigation of the action of horizontal forces upon various forms of roof and bridge trusses. 2000 w. Zeitschr d Oesterr Ing u Arch Ver—Dec. 16, 1904. No. 67331 D.

The Steel Framework of the Trinity Building, New York. An illustrated detailed description of a building of twenty-one stories, or nearly 300 feet above the curb. 2700 w. Eng Rec—Jan. 14, 1905. No. 67177.

Grain Pressure.

The Problem of Grain Pressure. Wilfrid Airy. Discusses the principal points in papers of Isaac Roberts and H. A. Janssen, and gives a general explanation of the problem. 3500 w. Engng—Jan. 6, 1905. No. 67202 A.

Reinforced Concrete.

A Five Years' Test of an Experimental Reinforced Concrete Arch of Sixty-Six-Foot Span. From a lecture by Herr Hoch, describing the construction of an experimental concrete arch reinforced by iron and the results of observations for a period of five years, when it failed. Ills. 2200 w. Cement—Jan., 1905. No. 67221 C.

Design and Construction of a Reinforced Concrete Wharf at Ymuiden, Holland. Illustrated description of a structure built by the government for the fishery harbor located there. 1800 w. Cement—Jan., 1905. No. 67223 C.

Notes on European Reinforced Concrete Structures. Remarks on papers recently read at a meeting of the Royal Inst. of British Archts. on Hennebique reinforced concrete structures. 1700 w. Eng Rec—Jan. 14, 1905. No. 67175.

Reinforced Concrete Construction Theoretically Considered. Sidney B. Williamson. Some of the general principles on which this material is based, with theoretical analysis by Prof. W. K. Hatt, as the result of tests made, and information from other authorities. Ills. 2000 w. Cement—Jan., 1905. No. 67222 C.

Report of Fire, Load and Water Test Made at the Fire-Testing Station, Columbia University, N. Y., upon a Kahn System, 15-Foot Span, Reinforced Concrete Floor, Constructed by the Trussed Concrete Steel Company. Ira H. Woolson. Ills. 1300 w. Cement—Jan., 1905. No. 67224 C.

Tests of Reinforced Concrete Beams. From the report of the Boston Transit Commission. An illustrated report of

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tests, giving size of beams and methods of reinforcing them. 1100 w. R R Gaz—Vol. XXXVIII, No. 3. No. 67282.

The Chapel of the U. S. Naval Academy, Annapolis. Illustrates and describes an interesting building under construction, in which reinforced concrete is extensively used. 800 w. Eng Rec—Jan. 14, 1905. No. 67174.

The Computation of Reinforced Concrete Beams and Plates (Beitrag zur Berechnung Armierte Betonbalken und Platten). J. Melan. Deriving formulas for beams and ribbed plates, together with a diagram of curves for practical use. 2000 w. 1 plate. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 17, 1904. No. 67381 D.

The Concrete-Steel Headworks of the Ontario Power Company, Niagara Falls. Describes the reinforced concrete work. Ills. 2500 w. Eng Rec—Jan. 14, 1905. No. 67181.

The Development of Reinforced Concrete in Europe. E. Probst. An illustrated article reviewing the development and describing types of construction. General discussion. 5000 w. Jour W Soc of Engrs—Dec., 1904. No. 67257 D.

The Greek Amphitheater at the University of California. C. W. Whitney. An illustrated description of the advantageous use of concrete for this work. 2800 w. Eng Rec—Dec. 31, 1904. No. 66958.

Typical Structures in Concrete-Steel. Describes and illustrates details of some typical buildings and other structures in concrete-steel. 2500 w. Builder—Jan. 7, 1905. Serial. 1st part. No. 67189 A.

See Also Civil Engineering, Bridges.

See Civil Engineering, Municipal.

Road Maintenance.

The Maintenance of New York State Roads. Suggestions from bulletin issued by Mr. Henry A. Van Alstyne, State Engineer, dealing with gravel, macadam, and stone roads. 2000 w. Eng Rec—Jan. 21, 1905. No. 67409.

Roofs.

Formulas for Hips and Valleys. O. E. Emrich. Formulas and diagrams, with brief explanation. 600 w. Eng Rec—Jan. 7, 1905. No. 67072.

Structural Engineering.

The Relation of the Engineer to the Architect. Corydon T. Purdy. Read at the convention of the Am. Inst. of Archts. Considers the various methods of accomplishing work requiring both architects and engineers, and offers suggestions for adjusting their relations. 7500 w. Eng News—Jan. 26, 1905. No. 67481.

Tunnels.

An Improved Method of Constructing Tunnel Linings (Die Richtige Tunnel-Kernbau-Methode). Michael v. Könyves-Toth. Describing an improved method of constructing a continuous concrete lining during the boring of a tunnel. 2000 w. 1 plate. Zeitschr d Oesterr Ing u Arch Ver—Dec. 30, 1904. No. 67333 D.

Tubular Tunnels in Wet Ground (Les Tunnels Tubulaires en Terrains Aquifères). C. Brault. A mathematical investigation of the stresses in submerged metallic-tube tunnels. 2000 w. Génie Civil—Dec. 24, 1904. No. 67311 D.

The Crossing of the English Channel. F. Arnodin. An explanation of the reasons why the author hesitates to recommend the construction of a tunnel beneath the English channel. 5400 w. Public Works—Jan., 1905. No. 67467 F.

Waterproofing.

Waterproofing Concrete Structures. W. H. Finley. Read before the Cement Users' Assn. On the necessity of waterproofing concrete, the importance of drainage, and the methods used by the writer. 2000 w. Eng Rec—Jan. 21, 1905. No. 67403.

Wind Pressure.

See Civil Engineering, Bridges.

MATERIALS OF CONSTRUCTION.

Bricks.

Sand Lime Bricks. H. Gerlings. Describes the methods of cementing the sand and lime, and other matters of interest in regard to their manufacture. 3000 w. Jour Chem, Met & Min Soc of S Africa—Nov., 1904. No. 67430 E.

Cement.

Materials Which Retard the Setting of Portland Cement. R. C. Carpenter. Gives a brief description of experiments made for the purpose of determining the regulating power on the cement of gypsum and chloride of calcium. 2200 w. Eng Rec—Dec. 31, 1904. No. 66961.

The Setting or Hydration of Portland Cement. Clifford Richardson. Read before the Assn. of Am. Portland Cement Mfrs. Gives results of investigations which are of scientific interest. 1200 w. Eng News—Jan. 26, 1905. No. 67478.

Cement Works.

The International Portland Cement Works at Hull, P. Q., Canada. John McClelland Bulkley. Illustrates and describes a factory comprising twenty buildings, that will have a capacity of about 2,000 bbls. per day. 2500 w. Eng Rec—Jan. 28, 1905. No. 67522.

We supply copies of these articles. See page 1038.

Concrete.

The Compression and Shearing Resistance of Concrete (Schub und Scherfestigkeit des Betons). H. Morsch. Experimental investigations in connection with the proportions of members of reinforced concrete. Two articles, 4000 w. Schweiz Bauzeitung—Dec. 24, 31, 1904. No. 67338 each B.

Glass.

Glass Considered as a Material of Construction (Le Verre Considéré Comme Matériau de Construction). J. Malette. Discussing the applications of wire glass, glass tiles, prisms, and other constructive applications. Serial. Part I. 2000 w. Revue Technique—Dec. 25, 1904. No. 67320 D.

Lime.

Tensile Strength of High Calcium and Magnesium Lime. George V. Rhines. A comparison of the strengths of these two limes made by George S. Mills is given, with other information of value. 1200 w. Munic Engng—Jan., 1905. No. 67218 C.

Plaster.

The Manufacture of Plaster of Paris (Procédé de Fabrication du Plâtre). Louis Périn. With illustration of the Périn furnace. and description of the process of manufacture. 2500 w. Génie Civil—Dec. 31, 1904. No. 67313 D.

Reinforced Concrete.

See Civil Engineering, Construction.

Sand.

Mortar Sand. J. C. Hain. Read before the Nat. Assn. of Cement Users. Treats of the properties of various qualities of sand for use in concrete, giving an account of tests with interesting results. 4400 w. Ry & Engng Rev—Jan. 21, 1905. No. 67410.

Timber.

Australian Hardwoods (Ueber Autralische Harthölzer). C. Froitzheim. Describing Karri and Jarrah, two varieties of Eucalyptus used for piles, cross ties, wood pavements, etc. 5000 w. Glaser's Annalen—Jan. 1, 1905. No. 67327 D.

The Strength of Timber Treated with Preservatives. A statement of the results of tests carried out at the St. Louis Exposition by the Bureau of Forestry, U. S. Department of Agriculture. 1200 w. Eng News—Jan. 12, 1905. No. 67152.

The Tasmanian Blue Gum—An Ideal Timber for Harbor Building. Harold J. Shepstone. It is one of the strongest, most durable and denses timbers in the world, and is immune from attacks of the sea-worm. 2300 w. Ills. Sci Am—Jan. 21, 1905. No. 67290.

Wood Preserving. James McKeon. Describes the destruction of piles by marine insects, and considers briefly some of the methods of preservation tried, especially the creosoting process. 2500 w. Pro Pacific C Ry Club—Dec., 1904. No. 67461 C.

MEASUREMENT.

Field Work.

Engineering Field Work in the Colonies. W. G. Bligh. An illustrated article describing a type of angular instruments suited for rough work, and new types which will save time and labor. 3500 w. Public Works—Jan., 1905. No. 67464 F.

MUNICIPAL.

Conduits.

See Electrical Engineering, Distribution.

Destructor Plant.

See Electrical Engineering, Generating Stations.

Dresden.

The Public Works of Dresden. Dr. Karl Leutemann. An illustrated description of the city and its pubic works. 4500 w. Public Works—Jan., 1905. No. 67469 F.

Fire-Protection.

The Continental Fire Service. Edwin O. Sachs. Notes on Continental fire-brigade organizations, and the lessons to be learned. The present article is largely introductory. 2800 w. Engng—Jan. 13, 1905. Serial. 1st part. No. 67448 A.

Pavements.

Development of Bitulithic Pavement. Frederic J. Warren. Read before the Mass. Highway Assn., at Boston. An explanation of theories and results. Ills. 2800 w. Munic Jour & Engr—Jan., 1905. No. 66979 C.

Sewage Disposal.

A Recent Visit to Twenty-Four British Sewage Works. M. N. Baker. A report of visits to British sewage purification works, their methods of treatment, and matters of interest. General discussion. 9300 w. Jour Assn of Engng Socs—Dec., 1904. No. 67250 C.

Combined Chemical and Biological Sewage Disposal Works at Chichester, England. Description of these works which have been recently enlarged. 2000 w. Eng Rec—Jan. 14, 1905. No. 67180.

New Sewage Disposal Works in Middlesex. Reginald Brown. Illustrated detailed description. 2400 w. Public Works —Jan., 1905. No. 67470 F.

Practice in Sewage Disposal. Henry C. H. Shenton. Read before the British Soc. of Engrs. The latest methods employed, from the engineer's side of the question.

We supply copies of these articles. See page 1038.

3000 w. Munic Jour & Engr—Jan., 1905. Serial. 1st part. No. 66978 C.

Sewage Disposal at Saratoga Springs, N. Y. Illustrated detailed description of recent improvements, embracing slow sand filtration beds in connection with septic tanks, a new main sewer, a small pump well and pumping station, an installation of electrically driven centrifugal pumps, etc. 4500 w. Eng Rec—Jan. 21, 1905. No. 67408.

The Bacterial Disposal of Sewage. G. Everett Hill. Discusses why sewage disposal is of vital interest, the methods in use, and the value of these methods. 6800 w. Jour Fr Inst—Jan., 1905. No. 67243 D.

The Functions of Various Types of Bacteria in the Purification of Sewage, with Some Methods for Their Quantitative Determination. H. W. Clark. A study in which attempts have been made to work out bacterial or bichemical tests which will give a bacterial measure of the changes which may occur in filters and filter effluents. 6500 w. Eng News—Jan. 12, 1905. No. 67153.

Sewerage.

A Recent Installation of a Liernur Sewerage System. Brief description of this system as recently applied in England. 1300 w. Eng Rec—Dec. 31, 1904. No. 66965.

Sewers.

A New Form of Reinforced Concrete Block Sewer Construction. An explanation of the construction and a statement of the advantages claimed. Ills. 1200 w. Eng News—Jan. 5, 1905. No. 67046.

The Harrisburg Sewer. S. M. Neff. Illustrated description of a concrete-steel intercepting sewer. 1600 w. Cement Age —Jan., 1905. No. 67490.

Sidewalks.

Sidewalk Construction for Small Cities. J. C. Herring. Notes on the methods of construction, materials used, grading, etc. 2500 w. Munic Engng—Jan., 1905. No. 67220 C.

Snow Removal.

Removal of Snow from City Streets. Leicester Allen. Discusses the cost of snow removal in New York City, and suggests the designing of a snow-melter that would lessen the expense. 2200 w. Eng Rec—Jan. 21, 1905. No. 67407.

Waste.

Municipal Waste. John H. Simon. Gives methods of disposal and reduction adopted after investigating systems of various cities. 2700 w. Munic Jour & Eng—Jan., 1905. No. 66980 C.

WATER SUPPLY.

Algae.

The Copper Sulphate Treatment for Algae at Middletown, N. Y. James M. Caird. A brief account of the treatment and results at the different reservoirs. 1200 w. Eng News—Jan. 12, 1905. No. 67155.

Corrosion.

Electrolytic Corrosion in Underground Pipes. Alec A. Beadle. An explanation of the change that takes place, and a suggestion for the prevention of corrosion. 1200 w. Elec Rev, N Y—Jan. 7, 1905. No. 67041.

Distribution.

The Arrangement of a Water Distribution System Fed by Two Separate Reservoirs (Ueber das Verhalten einer Wasserleitung die von Zwei Getrennten Hochreservoiren Gespeist Wird). Otto Seyller. Describing the water supply of Leoben, Austria, as extended by the inclusion of a second independent reservoir. 2500 w. 1 plate. Oesterr Wochenschr f d Oeffent Baudienst—Jan. 7, 1905. No. 67385 D.

Filtration.

Small Sand Filter Plant for a Hospital at Poughkeepsie, N. Y. An illustrated description of a small plant, important owing to its novel features. 2000 w. Eng Rec —Jan. 7, 1905. No. 67068.

Ground Water.

Measurements of Underflow Streams in Southern California. Prof. C. S. Slichter. An illustrated article describing measurements made at the narrows of the Rio Hondo and the San Gabriel River, California, and at the narrows of the Mohave River, near Victorville; describing also the underflow water used. 5500 w. Jour W Soc of Engrs—Dec., 1904. No. 67259 D.

The Problem of the Movement of Water Through Permeable Ground (Problem sul Moto dell 'Acqua a Traverso Terreni Permeabili). Pietro Alibrandi. An elaborate mathematical treatment, deriving equations for the movement of ground water under various conditions. 12000 w. Ann d Soc d Ing e d Arch Ital—No. 3, 1904. No. 67390 F.

London.

London Water Supply: Old and New Methods. W. J. Fisher. An interesting review of the history of the water supply of London, and the recent uniting of the eight private companies into one. 3500 w. Westminster Rev—Jan., 1905. No. 67209 D.

Minneapolis.

The Water Supply of Minneapolis. J. Frank Corbett. Gives charts showing re-

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sults of analysis of the water, and the number of cases of typhoid fever, with explanatory notes. 1300 w. Jour Assn of Engng Soc—Dec., 1904. No. 67249 C.

Pipe Scrapers.

Automatic Water Pipe Scrapers at Melbourne, Australia. Illustrates and describes an exceptionally compact automatic scraper. 2500 w. Eng News—Jan. 5, 1905. No. 67048.

Pumping.

Air-Lift Pumping Plant of the Redlands Water Co. An illustrated account of a test made in a plant in these irrigation works in California to determine its efficiency, with brief description of the plant. 1400 w. Eng Rec—Jan. 7, 1905. No. 67066.

Rainfall.

Maximum Rates of Rainfall at Boston. Charles W. Sherman. A record of rainfall from 1879 to 1904, inclusive, with discussion and comparison with records obtained elsewhere. 1500 w. Pro Am Soc of Civ Engrs—Dec., 1904. No. 66969 E.

Reservoirs.

Dams for Providing Water-Supply (L'Alimentation d'Eau par les Barrages). H. Peter. A description of several recent artificial reservoirs and illustrations of the dam across the valley of the Urve, near Aix-la-Chapelle. 2500 w. Bull Tech de la Suisse Rom—Dec. 25, 1904. No. 67378 D.

Water-Works.

The Water-Works of Porterville, California. Philip E. Harroun. An illustrated description of works for a town of about 2,000 inhabitants, with notes on the operation and cost. 8500 w. Pro Am Soc of Civ Engrs—Jan., 1905. No. 67501 E.

WATERWAYS AND HARBORS.

Bengal.

Inland Navigable Waterways of Bengal. Reviews the history of canal construction and river navigation, and its development. Ills. 2200 w. Engr, Lond—Dec. 30, 1904. No. 67143 A.

Canal.

Earthwork of the Seattle and Lake Washington Waterway Co. C. H. Rollins. Read before the Pacific Northwest Soc of Engrs. Describes the scheme and methods of construction of the canal connecting Puget Sound with Lake Washington. 4000 w. Eng News—Jan. 12, 1905. No. 67157.

Canal Conversion.

See Street and Electric Railways.

Canal Lifts.

A Design for a Canal Lift (Project d'Ascenseur pour Bateaux). Illustrating a design submitted for the Danube-Oder canal, employing a large revolving cylinder, carrying tanks for the boats. 1800 w. 1 plate. Génie Civil—Jan. 7, 1905. No. 67316 D.

Recent Canal Lifts (Neuere Schiffshebewerke). Hr. Krell. A discussion of the various propositions and designs for hydraulic lifts to replace locks in connection with the development of the internal waterways of Germany. 4000 w. Zeitschr d Ver Deutscher Ing—Dec. 24, 1904. No. 67302 D.

The International Competition for a Canal Lift (Der Internationale Wettbewerb für ein Kanal-Schiffshebewerk). B. Gerdau. Illustrating a design for an inclined plane entered in the Danube-Oder competition. 4500 w. 2 plates. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 24, 1904. No. 67383 D.

The Prize Designs in the International Competition for a Canal Lift (Die Preisgekrönten Projekte im Internationalen Wettbewerbe für ein Kanalschiffshebewerk). Karl Haberkall. The prize designs for the Danube-Oder Canal were for an inclined plane, and for a great revolving wheel. Two articles. 15,000 w. 7 plates. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 3, 10, 1904. No. 67380 each D.

Crane.

Floating Crane for the Harbor of Riga. (Schwimmkran für den Haben der Stadt Riga). L. Müller. Describing a powerful shear crane of 66 tons capacity arranged on a self-propelled float for harbor service. 2500 w. 1 plate. Zeitschr d Ver Deutscher Ing—Jan. 7, 1905. No. 67303 D.

Docks.

The Modernization of Ancient Docks. Brysson Cunningham. States the changes which have necessitated the enlargement of docks, and discusses the problems in connection with the work. Ills. 4000 w. Engng—Dec. 30, 1904. No. 67135 A.

Drainage.

The Inlet Swamp Drainage District in Illinois. A. M. Shaw. Abstract of a paper read before the Illinois Soc. of Engrs. & Survs. Discusses the principal difficulties with which the district has to contend. 1600 w. Eng News—Jan. 26, 1905. No. 67480.

Dredger.

An Interesting Powerful Steam Dredger for Harbor Work. Illustration, with brief description of the "Vulcan," a powerful dredger in use at Liverpool. 700 w. Sci Am—Jan. 14, 1905. No. 67159.

Folkestone.

Folkestone Harbor Extension Works. Percy C. Tempest. Brief illustrated description of the work. 1000 w. Public Works—Jan., 1905. No. 67466 F.

Lighthouse.

The Repairing of the Lighthouse at Swinemünde (Instandsetzung des Leuchtturmes in Swinemünde). H. Kohlenberg. The weather-beaten brick tower was incased in a new outer wall of hard brick, bonded to the old structure. 1200 w. Zentralblatt d Bauverwaltung—Dec. 17, 1904. No. 67397 B.

N. Y. Harbor.

The New York Harbor Entrance. Lewis M. Haupt. A review of dredging operations intended to improve the channel, showing the inadequacy of this method under the conditions of littoral drift, and advocating the use of suitably located training walls to cause the opening and maintaining of the channel by natural forces. 1500 w. Sci Am—Jan. 7, 1905. No. 67027.

Nile.

The Control of the Nile. Sir Hanbury Brown. An illustrated article dealing with the means adopted to make Egypt produce more. The irrigation question. 11,000 w. Public Works—Jan., 1905. No. 67462 F.

Panama Canal.

Isthmus Canal: Sea Level Versus Locks. William W. Redfield. A brief discussion, explaining the writer's reasons for favoring the San Blas route for the canal. 1500 w. Jour Assn of Engng Socs —Dec., 1904. No. 67251 C.

Panama Canal. Editorial statement of the present discussion of routes, outlining the plans that have been considered. 1600 w. Engng—Jan. 13, 1905. No. 67453 A.

The First Annual Report of the Isthmian Canal Commission. Such portions of the report as are of most interest to engineers are given. 7000 w. Eng News—Jan. 26, 1905. No. 67477.

The Revival of De Lesseps' Sea-Level Plan for the Panama Canal. Gen. H. L. Abbot. An examination of hydraulic problems involved in the sea-level scheme, showing its impracticability. 3000 w. Engineering Magazine — Feb., 1905. No. 67504 B.

The Work of the Commission on the Panama Canal. C. E. Grunsky. An authoritative account by a member of the commission of the policy which controls its work and of the results which have been accomplished. 4500 w. Engineering Magazine—Feb., 1905. No. 67510 B.

Reinforced Concrete.

See Civil Engineering, Construction.

Review.

Harbors and Waterways in 1904. A review of the important developments, especially in Great Britain. 3400 w. Engr, Lond—Jan. 6, 1905. No. 67204 A.

River Improvement.

Technical Methods of River Improvement as Developed on the Lower Missouri River, by the General Government, from 1876 to 1900. S. Waters Fox. Gives a brief description of the river, and of the more important works. Ills. 17,000 w. Pro Am Soc of Civ Engrs—Jan., 1905. No. 67502 E.

River Protection.

The Protection Works of the Banks of the Sutlej, British India (Travaux de Protection des Rives du Sutlej). G. Richon. Describing the dikes erected for the protection of the Kaiser-i-Hind bridge. 1800 w. 1 plate. Génie Civil—Dec. 17, 1904. No. 67308 D.

Shore Protection.

Shore Protection Works in Holland (Seeuferbauten in Holland). H. v. Horn. Illustrating and describing the dikes and protection works at the island of Walcheren, and the dunes at Pettem. 1800 w. 1 plate. Oesterr Wochenschr f d Oeffent Baudienst — Dec. 17, 1904. No. 67382 D.

The Essex Levels and Sea Walls. An illustrated article describing marsh protection and giving the history of the Essex levels, and the method of building new walls or dikes. 4500 w. Public Works —Jan., 1905. No. 67468 F.

Stream Regulation.

Steam Regulation in Upper Austria (Die Gewässerregulierung in Oberösterreich). S. Stern. Plans and illustrations of a number of mountain streams and the works constructed for their control. 4000 w. 1 plate. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 31, 1904. No. 67384 D.

Thames Barrage.

The Thames Barrage Scheme. Discusses a measure to be introduced for the consideration of Parliament which provides for endocking the river by the construction of a barrage between Gravesend and Tilbury. 3000 w. Builder—Jan. 14, 1905. No. 67427 A.

Wharf.

The London, Brighton, and South Coast Railway Company's Deptford Wharf. Illustrated description of the recent installation of electric cranes. 2800 w. Engng—Jan. 13, 1905. No. 67452 A.

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ELECTRICAL ENGINEERING

COMMUNICATION.

Automatic Telephony.

Some Latest Features of Automatic Telephony. Norman G. Meade. An explanation of the more important points of the automatic system, giving diagrams showing the various circuits and details. 2200 w. Elec Wld & Engr—Dec. 31, 1904. No. 66989.

Cables.

The Manufacture of Air-Insulated Cables. Emile Guarini. Illustrates and describes the process at Messrs. Siemens & Halske's cable works, at Nonnendamm, where air is used as an insulating medium in connection with the manufacture of telephone cables. 1000 w. Elec Rev, N Y—Jan. 21, 1905. No. 67291.

Recorder.

The Orling-Armstrong Electro-Capillary Recorder. Illustrated detailed description of this apparatus and its operation. It is peculiarly adapted for cable work. 1700 w. Sci Am Sup—Jan. 21, 1905. No. 67288.

Space Telegraphy.

A New American System of Wireless Telegraphy. A. Frederick Collins. Describes the system of James Foster King. Ills. 2500 w. Elec Wld & Engr—Jan. 21, 1905. No. 67425.

Can the Receiver Distinguish Between the two Forms of Transmitted Waves? (Lässt sich in der Drahtlosen Telegraphie der Empfänger auf die Beiden Wellen des Senders. Abstimmen). Dr. George Seibt. A discussion of the behaviour of various forms of receivers for space telegraphy. 2500 w. Elektrotech Zeitschr—Dec. 29, 1904. No. 67364 B.

The Effect of Subdivision of Spark Gap and Capacity upon Damping (Ueber den Einfluso der Unterteilung einer Funkenstrecke und der Kapcität auf Funkenentladungen). Dr. G. Benischke. An examination of Slaby's method of tuning in connection with the behaviour of insulators and lightning arresters. 3000 w. Elektrotech Zeitschr—Jan. 5, 1905. No. 67366 B.

The Tuning of Transmitters for Space Telegraphy (Die Abstimmung Funkentelegraphischer Sender). A Slaby. A discussion of the selective tuning of directly excited transmitters by a regulation of the spark gap resistance. 7500 w. Elektrotech Zeitschr—Dec. 22, 1904. No. 67360 B.

Statistics.

Statistics of the Telephone and Telegraph Industries. Information from a Census bulletin on telephony and telegraphy for the year ending Dec. 31, 1902. 2700 w. Elec Wld & Engr—Jan. 21, 1905. Serial. 1st part. No. 67422.

Telegraphone.

The Telegraphone. Dr. Z. B. Babbitt. An interesting description of this invention of Valdemar Poulsen, its workings and the uses to which it may be applied. 1600 w. Jour Fr Inst—Jan., 1905. No. 67244 D.

Telegraphy.

Direct Wheatstone Working Between England and Teheran. T. W. Stratford-Andrews. Technical description, with notes, map and diagram of connections, at London station. 2800 w. Elect'n, Lond—Jan. 13, 1905. No. 67437 A.

Telephony.

Some Interesting Phases of Long-Distance Telephony. S. G. McMeen. An interesting discussion, touching upon simultaneous telephony and telegraphy, long-distance trunks, booster batteries, ticket-tube system, etc. General discussion. Diagrams. 9200 w. Jour W Soc of Engrs—Dec., 1904. No. 67258 D.

Transmitter.

The Kotyra Transmitter (Le Transmetteur Kotyra). R. Wittebolle. Describing an improved keyboard transmitter for the rapid sending of Morse characters over a telegraph wire. 2000 w. Revue Technique—Dec. 25, 1904. No. 67318 D.

DISTRIBUTION.

Cables.

The Charging of a Cable Through a Condenser and Resistance. Oliver Heaviside. The object of the article is to promote the study of special cases numerically and graphically, especially as regards the inclusion of the self-induction of the cable. 2800 w. Elect'n, Lond—Dec. 23, 1904. No. 66997 A.

Conduits.

The Municipal Conduit System of Erie, Pa. Benjamin E. Briggs. Map and sections, with description of underground conduits for electric wires and cables. 2500 w. Munic Engng—Jan., 1905. No. 67217 C.

Fuses.

The Uncertainty of Fuses. Considers

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some of the causes of uncertainty, with remarks on the recent researches of Oelschlager. 1500 w. Elec Rev, Lond—Dec. 30, 1904. No. 67132 A.

Protection.

Protection Devices for High-Tension Overhead Wires (Schutzvorrichtung für Starkstromleitungen mit Oberirdischer Stromzuführung). Fr. Krizik. Especially describing arrangements of guard wires for the protection of telegraph and telephone wires from contact with overhead trolley wires. 1200 w. Zeit f Elektrotechnik—Dec. 18, 1904. No. 67371 D.

Relays.

Discriminating Relays and Cut-Outs. M. B. Field. Deals with wattmeter relays, and briefly considers compound differential devices. Ills. 2000 w. Elec Rev, Lond—Jan. 13, 1905. No. 67435 A.

Switches.

Distance-Control Switches and Their Lay-Outs in Stations. W. E. Warrilow. Deals with the chief types of oil switches in use, their design and assembly in conjunction with other apparatus to form a power-house or substation switchgear. 2000 w. Elec Engr, Lond—Jan. 6, 1905. Serial. 1st part. No. 67195 A.

Wire Stresses.

The Calculations of Sag and Stresses in a Freely Stretched Wire (Beitrag zur Berechnung des Durchhangs und der Spannung von Frei Gespannten Drähten). A. Löwit. Giving formulas and diagrams for the stresses in an overhead wire for various spans and sags. 800 w. Zeit f Elektrotechnik — Dec. 18, 1904. No. 67370 D.

ELECTRO-CHEMISTRY.

Dry Battery.

Practical Experience in Dry Battery Construction (Trockenelementbau nach Praktischen Versuchen). Walther Stöckigt. A brief, clear description of the general construction of successful working dry batteries. 1200 w. Elektrochem Zeitschr—Dec., 1904. No. 67372 G.

Electric Smelting.

The Froges-Heroult Electro-Metallurgical Process (Procédé Electro-Métallurgiques Froges-Héroult). Ch. Combes. A description of the manufacture of steel by the Héroult electric process at La Praz. 3000 w. L'Electrochimie—Dec., 1904. No. 67391 D.

The Neuburg-Minet Electric Furnace for the Production of Iron and Steel. Dr. Albert Neuburger and A. Minet. Illustrates and describes an electrical furnace for which it is claimed that the process may be carried out with small consumption of electricity, and that the electricity may be generated cheaply, and allows of the use of cheap waste gases in the manufacture. 2000 w. Min Jour—Dec. 31, 1904. No. 67123 A.

Electrolysis.

The Electrolytic Separation of Metals (Die Elektrolytische Fällung der Metalle). Arthur Fischer and R. J. Boddaert. Discussing especially the effect of an active agitation of the electrolyte in the separation of the more important metals. 4000 w. Zeitschr f Elektrochemie—Dec. 23, 1904. No. 67373 D.

Resistance Furnaces.

Miscellaneous Accessories of Resistance Furnaces. F. A. J. Fitz Gerald. Discusses principally means for regulating the voltage and methods of electrode connections. 4000 w. Elec-Chem & Met Ind—Jan., 1905. No. 67105 C.

Review.

Progress in the Electrochemical and Electrometallurgical Industries in 1904. John B. C. Kershaw. Gives some details of new processes and reviews the position of the older industries during the year. 2000 w. Elec Rev, N Y—Jan. 14, 1905. No. 67170.

Zinc Coatings.

Investigation of the Properties of Zinc Coatings. Charles F. Burgess. A report of investigations undertaken at the University of Wisconsin to determine, if possible, the relative value of zinc deposited by the electrolytic or "cold" processes and the metal as applied by the "hot" or dipping methods. 5000 w. Elec-Chem & Met Ind—Jan., 1905. No. 67107 C.

ELECTRO-PHYSICS.

Magnetism.

The Theory of Magnetism (Sur la Theorie du Magnetism). P. Langevin. An examination of the corroboration of Curie's laws by the theory of electrons. 900 w. Comptes Rendus—Dec. 26, 1904. No. 67325 D.

Thermo-Electricity.

The Thermo-Electricity of Aluminum Alloys (Sur la Thermo-Electricité des Alliages d'Aluminium). Hector Pécheux. Data and results of tests upon alloys of aluminium with tin, lead, bismuth, magnesium, antimony and zinc. 700 w. Comptes Rendus—Dec. 26, 1904. No. 67324 D.

Voltage.

The Rise of Pressure in Electric Conductors and Apparatus (Ueber Spannungserhöhungen in Elektrischen Leitungen und Apparaten). Dr. Georg Seibt.

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An examination of the momentary rise in voltage which occurs upon the making or breaking of an electrical contact. 4000 w. Elektrotech Zeitschr—Jan. 12, 1905. No. 67368 B.

GENERATING STATIONS.

Alternators.

Design of Alternators. A. Press. Gives formulas and explanation. 600 w. Elec Rev, Lond—Dec. 23, 1904. No. 66998 A.

Antwerp.

The Power House of the Antwerp Electric Tramways (Station Centrale des Tramways Electriques d'Anvers). A general description, with photographs of the engines, and section of the building. There are three generating sets, of 1200 h.p. each. 1200 w. Génie Civil—Dec. 17, 1904. No. 67307 D.

Boston.

Modern Central Station Design as Exemplified by the New Turbo-Generator Station of the Edison Electric Illuminating Company of Boston. I. E. Moultrop. An illustrated detailed description of this station and its equipment. 5700 w. Pro Am Inst of Elec Engrs—Jan., 1905. No. 67261 D.

British Practice.

The Tendency of Practice in Power Station Engine and Boiler Plant. Francis H. Davies. Reviews the development of steam and electricity supply in England, particularly noting the difference that has existed in horse power installed between the leading types of boilers and engines at various periods during the last few years. 1200 w. Elec Rev, Lond—Dec. 30, 1904. No. 67128 A.

Commutators.

Repairing Commutators. Norman G. Meade. Gives detailed instructions for repairing and refilling commutators with the facilities that may be found in a manufacturing plant. Ills. 1800 w. Power—Jan., 1905. No. 67022 C.

Compounding.

Compensated Alternate Current Generators. Miles Walker. Abstract of a paper read at Manchester, Eng., before the Inst. of Elec. Engrs. Describes some methods of compensating, especially the method of the author which preserves the field excitation constant and utilizes the armature field to raise the voltage. Ills. 3000 w. Elec Rev, Lond—Dec. 30, 1904. No. 67131 A.

Destructor Plant.

The Combination of Dust Destructors and Electricity Works Economically Considered. Frank Broadbent. A critical review of a recent paper by W. P. Adams on the above subject. 2700 w. Elec Rev, Lond—Dec. 23, 1904. No. 66999 A.

Dynamos.

Acyclic (Homopolar) Dynamos. J. E. Noeggerath. Describes in outline the design, and some results obtained with, a 300-kw. 500-volt turbine-driven acyclic generator, discussing the uncertainty as to the magnetic and electrical conditions prevailing in this type, and the difficulties encountered in collecting large currents from a generator running at a high rate of speed. Ills. 1800 w. Pro Am Inst of Elec Engrs—Jan., 1905. No. 67260 D.

Eccentricity.

The Determination of the Magnetic Pull in Cases of Eccentricity (Berechnung des Einseitigen Magnetischen Zuges bei Exzentrizität). J. K. Sumec. Deriving formulas for the computation of the one-sided pull for a given eccentricity of rotor in a dynamo. 1000 w. Zeit f Elektrotechnik—Dec. 18, 1904. No. 67369 D.

Gas Power.

Some Continental Central Stations Operating with Gas Engines. Franz Koester. An illustrated article describing a few of these stations. 3500 w. Elec Rev, N. Y.—Jan. 14, 1905. No. 67172.

Hydro-Electric.

Canadian Niagara Power To-Day. An illustrated description of the fine plant of this company. 2500 w. Elec Wld & Engr—Jan. 7, 1905. No. 67093.

Duluth Hydro-Electric Development. Dwight E. Wooodbridge. Illustrates and describes the project for the improvement of the water power of the St. Louis River, at the head of Lake Superior. 1800 w. Ir Age—Jan. 19, 1905. No. 67271.

Electric Power for Minnesota Ore Roads. An illustrated account of an important power development on the St. Louis River. It furnishes power for mines and ore roads, and for the city of Duluth. 2000 w. Ir Trd Rev—Jan. 12, 1905. No. 67103.

Electrical Power from the Welland Canal. An illustrated detailed description of the development which provides power for Hamilton, Canada, and other places in the locality. 2500 w. Elec Wld & Engr—Jan. 21, 1905. Serial. 1st part. No. 67423.

Hydro-Electric Power Plant at Turbigo. Illustrates and describes this recently completed plant. 1500 w. Engr, Lond—Dec. 23, 1904. No. 67019 A.

Hydro-Electric Power Plants in the Canadian Niagara District. Cecil B. Smith. A fully illustrated account of the

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plant recently erected on the Canadian side of the Niagara River with an ultimate capacity of 400,000 horse power. 5000 w. Engineering Magazine—Feb., 1905. No. 67505 B.

Morgan's Falls, Ga., Transmission Plant. Lamar Lyndon. Illustrates and describes a plant costing nearly a million and a half dollars, and having a capacity of 14,000 H. P. 2500 w. Elec Wld & Engr—Dec. 31, 1904. No. 66990.

St. Joseph River Power Development. Illustrated description of a system which will furnish power to northern Indiana and southern Michigan. 1400 w. Elec Wld & Engr—Dec. 31, 1904. No. 66988.

Typical American Hydraulic and Transmission Plant. C. W. Whitney. Illustrated detailed description of the American River Electric Company's system in central California. 6800 w. Am Elect'n —Jan., 1905. No. 67036.

Omaha.

Electric Supply in the Gate City. Alton D. Adams. An illustrated account of the service in Omaha. 2000 w. Elec Rev, N. Y.—Jan. 14, 1905. No. 67173.

Power Supply.

Electric-Power Supply from Central Stations in Great Britain. G. L. Addenbrooke. A complete survey of the projects under consideration, with illustrated descriptions of the South Wales, Newcastle, Thornhill, and other power stations. 5000 w. Engineering Magazine—Feb., 1905. No. 67507 B.

Regulation.

The Electro-Mechanical Control of Electric Generating Sets (Compoundage Electro-Mécanique des Groupes Electrogènes). M. De Kermond. A description of the Routin method of regulation by controlling the excitation of the dynamo and the speed of the engine. 3000 w. L'Electricien—Dec. 24, 1904. No. 67386 B.

The Routin Electro-Mechanical Regulator (Das Elektromechanische Reguliersystem von Routin). F. Brock. By means of an auxiliary dynamo the excitation of the generator is varied with the load, and the weighting of the engine governor is altered. 1500 w. Elektrotech Zeitschr—Dec. 22, 1904. No. 67362 B.

Statistics.

Statistics of Generating Stations in Germany (Statistik der Elektrizitätswerke in Deutschland). The annual tabular review of the electric power and lighting stations in the German empire, with summary and review in comparison with preceding years. 20000 w. Elektrotech Zeitschr—Jan. 12, 1905. No. 67367 B.

See also Street and Electric Railways.

LIGHTING.

Dublin.

The City of Dublin Electric Lighting. An illustrated detailed description of the arc-lighting. 1100 w. Engng—Dec. 30, 1904. No. 67138 A.

Lighting Stations.

See Electrical Engineering, Generating Stations.

Mercury Vapor.

The Mercury-Vapor Lamp and Mercury Vacuum Devices (Die Quecksilberlampe und sonstige Quecksilber-Vakuumapparate). Max von Recklinghausen. Discussing the Cooper-Hewitt lamp and the applications of the device as a current rectifier. 4500 w. Elektrotech Zeitschr—Dec. 22, 1904. No. 67363 B.

Nernst Lamps.

City Street Lighting at Sewickley, Pa., a Successful Six-Glower Nernst Lamp System. Brief illustrated description of the first installation of its kind in the United States. 700 w. Elec Rev, N. Y. —Jan. 21, 1905. No. 67292.

Photometry.

See Electrical Engineering, Measurement.

Train Lighting.

Electric Train Lighting in Connection with the Austrian Mail Service (Ueber Elektrische Zugbeleuchtung mit besonderer Berücksichtigung der Oesterreichischen Bahnpostwagen). Karl Wallitschek. A description of the use of accumulators and axle-driven dynamos for lighting the railway post-office cars in Austria. Two articles. 5000 w. Zeitschr d Oesterr Ing u Arch Ver—Jan. 6, 13, 1905. No. 67336 each D.

The Electric Lighting of Railway Trains. Dr. Alfred Gradenwitz. Illustrates and describes a system designed by Mr. Aichele, and being brought out by the Aktien-Gesellschaft Brown, Boveri & Co. of Baden, Switzerland. Each car has a lighting plant of its own. 3800 w. Elec Engr, Lond—Jan. 13, 1905. No. 67440 A.

MEASUREMENT.

Laboratory Testing.

Alternating Current Laboratory Testing. George H. Rowe. The first of a series of articles based on lectures delivered to students engaged in the experimental study of alternating current phenomena. Experimental investigations. Ills. 1600 w. Jour of Elec—Jan., 1905. Serial. 1st part. No. 67100 C.

Meters.

Electricity Meters. C. H. W. Gerhardi.

We supply copies of these articles. See page 1038.

A classification and description of electric meters. Ills. 2500 w. Elect'n, Lond—Jan. 6, 1905. Serial. 1st part. No. 67197 A.

Photometry.

Photometry for Central Station Engineers. Lancelot W. Wild. Describes how photometric measurements may be made in a central station both accurately and quickly, and without employing any very expensive apparatus, nor a specially skilled testing staff. 1500 w. Elec Rev, Lond—Jan. 6, 1905. No. 67196 A.

Potentiometer.

A Multiple-Dial Potentiometer. Albert Campbell. Describes a low-resistance instrument, aiming at ease of mechanical construction, accuracy, convenience of reading, and compactness. 400 w. Elec Rev, Lond—Dec. 30, 1904. No. 67130 A.

Testing.

The Electrical Testing Laboratories. Clayton H. Sharp. An illustrated description of the plant in New York, on the corner of 80th St. and East End Ave., and of its equipment for the work. 5200 w. Elec Wld & Engr—Jan. 7, 1905. No. 67096.

MOTORS.

Balancers.

On Direct-Current Balancers. A. E. Kennelly and S. E. Whiting. Aims to express the fundamental conditions of operation of such balancers in a form adapted for use in electric driving. Diagrams. 1500 w. Elec Wld & Engr—Jan. 17, 1905. No. 67097.

Commutation.

Commutation at Starting of Alternating-Current Motors with Commutator. Marius Latour. Discusses a special construction for commutator armatures, in which resistance leads are used between the winding and the commutator, in connection with the starting of the single-phase motor. 1200 w. Elec Wld & Engr—Jan. 14, 1905. No. 67186.

Controller.

Apparatus for Starting and Controlling Electric Motors (Dispositif de Mise en Marche et de Changement de Marche pour Electro-Moteurs). Illustrating and describing an improved form of controller. 1800 w. L'Electricien—Jan. 14, 1905. No. 67388 B.

Electric Driving.

Electric Driving of Textile Mills. W. B. Woodhouse. States briefly the advantages of electrical driving, with some facts on the cost of driving by motors, taking a supply from the mains of a power company or electricity works. 3300 w. Elect'n, Lond—Jan. 6, 1905. No. 67198 A.

Electric Power in French Gas Works. Illustrates and describes the construction and methods of operating electrically-operated machines for charging retorts and removing coke. 800 w. Elec Wld & Engr—Jan. 21, 1905. No. 67424.

The Electrical Equipment of the New York "Times" Building. Explains reasons for taking the supply of current from the N. Y. Edison Co. and describes the service, applications, &c. Ills. 1700 w. Elec Rev, N. Y.—Jan. 28, 1905. No. 67518.

The Thompson-Ryan Motor and Its Application to Machine Tools. An illustrated description of an electric motor giving wide speed range by means of field control. 3300 w. Ir Age—Jan. 5, 1905. No. 67004.

Electric Vehicles.

See Mechanical Engng., Automobiles.

Induction Motors.

The Determination of Straying and the Measurement of the Constants for Idle Running for Induction Motors (Streuungsmessung an Drehstrommotoren und Bestimmung der Leerlaufskonstanten). Robert Moser. A general mathematical treatment, making use of the vector analysis. 5000 w. Elektrotech Zeitschr—Jan. 5, 1905. No. 67365 B.

Loads.

Stand-by Charges and Motor Load Development. A. M. Taylor. A short abstract of a paper read before the Birmingham Local Sec. of the Inst. of Elec. Engrs. Also discussion. Gives a method of determining the actual cost of the load at any time of the day. 4000 w. Elec Engr, Lond—Jan. 13, 1905. No. 67444 A.

Steering.

See Marine and Naval Engineering.

TRANSMISSION.

Lightning.

Lightning Protection. Killingworth Hedges. Illustrated description of special clamps designed by the writer which project from the wall, and of methods of installation adopted. 1600 w. Public Works—Jan., 1905. No. 67463 F.

The Gola Lightning Arrester (Parafoudre Système Gola). J. A. Montpellier. Describing an improved arrangement of series lightning arrester, applicable for currents up to 30,000 volts and 250 amperes. 800 w. L'Electricien—Jan. 7, 1905. No. 67387 B.

Line.

New 30,000-Volt, Steel Pole, Long

Span, Transmission Line. Describes the line from Los Angeles to Inglewood, a distance of fourteen miles. Ills. 1500 w. Jour of Elec—Jan., 1905. No. 67102 C.

Lombardy, Italy.

The First Transmission of Power in Europe at 40,000 Volts. Enrico Bignami. Illustrated description of the electric transmission system from Gromo to Nembro, in Lombardy. 2400 w. Elec Rev, N. Y.—Jan. 7, 1905. No. 67040.

Space Transmission.

The Transmission of Electrical Energy Without Works as a Means for Furthering Peace. Nikola Tesla. A lengthy article explaining the writer's views and his belief in the possibility of the economic transmission of power without wires. 4800 w. Elec Wld & Engr—Jan. 7, 1905. No. 67094.

Switches.

High-Tension Switch Gear. L. Andrews. Abstract of a paper read before the Manchester Sec. of the Inst. of Elec. Engrs. Discusses methods of control, the devices used, &c. Brief general discussion. 2200 w. Elect'n, Lond—Dec. 30, 1904. No. 67133 A.

High-Tension Switchgear. L. Andrews. Read before the Manchester Sec. of the Inst. of Elec. Engrs. The present article considers mechanical v. electrical remote control, separation of phases in circuit breakers, discriminating circuit breakers, &c. 2500 w. Mech Engr—Jan. 7, 1905. Serial. 1st part. No. 67193 A.

MISCELLANY.

India.

Electricity in India and Burma. E. C. Deepholt. A brief account of the gradual progress of electricity at the present day and the future outlook. 2000 w. Elec Engr, Lond—Jan. 13, 1905. No. 67441 A.

Review.

Electrical Engineering in 1904. Principally a review of the industry in England. 4800 w. Engr, Lond—Jan. 6, 1905. No. 67206 A.

Electricity in 1904. A review of the progress made in electrical science and arts during the past year. 2700 w. Elec Rev, N. Y.—Jan. 14, 1905. No. 67168.

Review of the Year in Great Britain and the Continent of Europe. C. L. Durand. A general review of the progress in electric traction and other electrical industries. 3200 w. Elec Rev, N. Y.—Jan. 14, 1905. No. 67171.

INDUSTRIAL ECONOMY

Copper Trade.

The American Copper Trade. Horace J. Stevens. Information concerning the sources of supply, the features of individual mines, foreign trade, &c. 3000 w. Ir Age—Jan. 5, 1905. No. 67008.

Cost Keeping.

Cost Keeping in an English Machine Tool Works. J. William Chubb. An account of a system put in practice by an English firm, and planned by Mr. Charles Taylor, of Birmingham. 2500 w. Am Mach—Vol. 28, No. 4. No. 67473.

Methods of Figuring Costs. C. E. Bement. Read before the Mich. Engng. Soc. Explains briefly the method used in a shop manufacturing "gang plows." 1800 w. Eng Rec—Jan. 21, 1905. No. 67405.

Gold Production.

See Mining and Metallurgy, Gold and Silver.

Iron Trade.

The Present State and Outlook of the Iron Trade in Spain. A report of progress, with a discussion of the industry and its possibilities. 2800 w. Ir & Coal Trds Rev—Jan. 6, 1905. Serial. 1st part. No. 67208 A.

Metal Markets.

Lead, Copper, and Tin in 1904. E. A. Caswell. Reviews the features of the market during the year. 3800 w. Ir Age—Jan. 5, 1905. No. 67003.

Patent Laws.

The United States Patent Laws. Historically and Practically Considered. Cyrus N. Anderson. Reviews briefly early English laws relating to patents, and discusses the laws enacted by the United States Government. 5000 w. Jour Fr Inst—Jan., 1905. No. 67247 D.

Prizes.

The Prizes Awarded by the French Academy for 1904 (Prix Décernés Année 1904). The reports of the various committees of the *Académie des Sciences*, announcing the awards of the prizes. 20000 w. Comptes Rendus—Dec. 19, 1904. No. 67321 D.

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Silver Production.

See Min. and Metallurgy, Gold & Silver.

Specifications.

Engineers' Specifications. Observations on specifications in general and the legal effect of clauses of particular hardship to contractors. 3200 w. Engr, Lond—Dec. 30, 1904. No. 67142 A.

Tin Plate.

The Sheet and Tin Plate Industries. B. E. V. Luty. Discusses the demand and supply, the price movement, wage matters, &c. 4000 w. Ir Age—Jan. 5, 1905. No. 67001.

Wages.

Capital and Labor in America (Kapital und Arbeit in Amerika). M. A. Nüscheler. Discussing especially methods of determining wages, including day work, piece work, and the premium and contract systems. 3000 w. Glasers Annalen—Jan. 1, 1905. No. 67329 D.

Dealing with the Unemployed. J. Keir Hardie. A discussion of this problem, outlining the scope of voluntary agencies for dealing with distress and the reforms necessary. Refers especially to England. 8000 w. Nineteenth Cent—Jan., 1905. No. 67210 D.

MARINE AND NAVAL ENGINEERING

Battleship.

Machinery of the Italian Battleship Regina Margherita. Illustrated detailed description of the vessel and its equipment, with report of trials. 2000 w. Engr, Lond—Jan. 6, 1905. No. 67207 A.

Cargo Steamer.

Stone Handling Plant of the Lake Shore Stone Co., Belgium, Wis. Illustrates a stone-carrying steamer, equipped with mechanical conveyors for unloading the cargo, and describes the methods of loading at the quarry. 2000 w. Eng News—Jan. 19, 1905. No. 67285.

Conning Tower.

The Conning Tower of a War Ship (La Torra di Comando nelle Navi da Guerra). Edwin Cerio. A criticism of present conning towers on various battle ships, with suggestions for improvements by subdivision. 2500 w. Rivista Marittima—Dec., 1904. No. 67357 H.

Engines.

See Mechanical Engineering, Steam Engineering.

Floating Crane.

A New One-Hundred Ton Floating Crane. Illustrates and describes this powerful machine for the New York Navy Yard, and gives an account of some of the work it has already accomplished. 2000 w. Marine Engng—Jan., 1905. No. 67030 C.

Motor Boats.

A Twelve-Cylinder 150-B. H. P. Racing Marine Gasoline Motor. Illustration, with detailed description. 1500 w. Sci Am Sup—Jan. 28, 1905. No. 67500.

A Two-Stroke Marine Motor. Illustrates and describes the Webster and Bickerton four-cylinder, two-cycle marine motor, with open type cranks, and magneto high-tension ignition. It can be used for other purposes and will work on paraffin. 1600 w. Autocar—Jan. 14, 1905. No. 67432 A.

Improved Speed-Change Gear for Motor Boats (Nouveau Changement de Marche Progressif pour Canots à Petrole). A description of the Julien gear for enabling a gradual change of speed for the propeller of a motor boat driven by a gasoline motor. 1800 w. Revue Technique—Dec. 25, 1904. No. 67319 D.

Motor Lifeboats. W. G. Windham. States some of the advantages and disadvantages of a petrol engine as fitted to a life boat, giving some practical hints on the fitting of a motor. Ills. 2000 w. Autocar—Dec. 31, 1904. No. 67125 A.

Powering.

Pow ring Ships. Edwin Cerio. An explanation of the methods of investigation both mathematical and experimental, for determining the resistance of ships. Marine Engng—Jan., 1905. Serial. 1st part. No. 67034 C.

Propellers.

Practical Points About the Screw Propeller. W. F. Durand. Discusses the design, construction and operation of screw propellers for marine propulsion. Ills. 2800 w. Marine Engng—Jan., 1905. Serial. 1st part. No. 67032 C.

The Size of Screw Propeller Blades (La Grossezza delle Pale d'Elica). N. Pecoraro. An examination of the efficiency of screw propellers in connection with the effective portion of the surface of the blades. 4000 w. 6 plates. Rivista Marittima—Nov., 1904. No. 67356 H.

Steering.

Electric Steering Control of Ships. Il-

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lustrated detailed description of the installation on the naval ship "Baden." 1600 w. Marine Engng—Jan., 1905. No. 67033 C.

Survey Steamer.

Coast & Geodetic Survey Steamer Pathfinder. Illustrated description of this vessel and its equipment. 2500 w. Marine Engng—Jan., 1905. No. 67035 C.

Torpedo Boats.

Some Points of Interest in Torpedo-Boat Construction. Harold E. Yarrow. Read before the Junior Inst. of Engrs., London. Briefly discusses the hull, riveting, vibration, lubrication, steam pipes, &c. 2500 w. Naut Gaz—Jan. 12, 1905. No. 67162.

Troopship.

Trials of the Troopship "Dufferin." Gives a report of the steam trials, and describes some of the special fittings. 1000 w. Engng—Dec. 30, 1904. No. 67139 A.

MECHANICAL ENGINEERING

AUTOMOBILES.

Alcohol.

Alcohol as a Fuel for Motor Cars. An interview with Dr. Ormondy, discussing why alcohol is not more generally used, its advantages, the working of the alcohol engine, &c. 2300 w. Autocar—Jan. 14, 1905. No. 67433 A.

American Car.

A New American Automobile. Illustrated description of the Christie racer. 1200 w. Sci Am—Jan. 28, 1905. No. 67497.

Exhibitions.

Features of Leading Cars at Paris Show. An illustrated article describing changes for the season of 1905 in the construction of frames, engines, clutches, carbureters, and control systems. 4500 w. Automobile—Dec. 31, 1904. No. 66972.

Fifth Annual Show in New York. An illustrated general description of the exhibits and interesting features. 6200 w. Automobile—Jan. 21, 1905. No. 67299.

Foreign Cars.

Foreign Automobiles at the Importers' Salon. Illustrations, with brief descriptions, of cars exhibited at the Macy Building, in New York. 2000 w. Sci Am—Jan. 28, 1905. No. 67494.

Garages.

Heating and Ventilation of Garages. N. B. Pope. Suggestions for small garages and private motor-houses. 1400 w. Motor-Car Jour—Jan. 14, 1905. No. 67426 A.

Gasoline Truck.

A Gasoline Truck Driven by All Four Wheels. Illustrated description. 800 w. Sci Am—Jan. 28, 1905. No. 67495.

Locomotive.

See Railway Engineering, Motive Power.

Mercedes.

The 1905 70 H. P. Mercedes Car. Illustrated description of the latest type of Mercedes car. 1200 w. Autocar—Dec. 24, 1904. No. 67013 A.

Oils.

See Mechanical Engineering, Materials.

Omnibuses.

The Straker-Squire Petrol Omnibuses and Commercial Vehicles. Illustrated description, giving full particulars of these vehicles. 2500 w. Auto Jour—Jan. 14, 1905. Serial. 1st part. No. 67431 A.

Powering.

Power Calculations for Electric Vehicles. H. H. Kennedy. Suggestions for calculating the power equipment of a vehicle propelled by storage batteries and electric motors. 1200 w. Am Mach—Vol. 28, No. 2. No. 67099.

Recent Models.

Some Leading Automobiles of the Present Year. Brief descriptions, with illustrations. 2200 w. Sci Am—Jan. 28, 1905. No. 67492.

Siddeley.

The 12 H. P. Two-Cylinder Siddeley Car. Illustrated detailed description of a car which has recently started on a 5,000 miles officially observed tour. 1500 w. Autocar—Jan. 7, 1905. No. 67191 A.

Speed Gear.

How a Change Speed Gear Works. Illustrates and describes the working of the gear fitted to the Panhard-Levassor cars. 1000 w. Autocar—Jan. 7, 1905. No. 67190 A.

Sunbeam.

The Sunbeam 12 H. P. Car. Illustrated description of a chain-driven car which has the whole of the transmission entirely protected. 1300 w. Autocar—Dec. 31, 1904. No. 67124 A.

Suspension.

Automobiles with Three Axles (Automobiles à Trois Essieux). Lt. Col. G.

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Espitallier. A description of the Lindecker system of suspension for heavy vehicles, using three axles and equalizing levers. 2000 w. Génie Civil—Dec. 31, 1904. No. 67312 D.

Touring Cars.

Model C National Touring Car. An illustrated description of an attractive gasoline touring car of recent design. 1500 w. Automobile—Jan. 7, 1905. No. 67055.

The National Touring Car. Illustrated detailed description. 1800 w. Sci Am—Jan. 28, 1905. No. 67496.

The New Ardsley Touring Car. An illustrated detailed description of an "assembled" car which is reported superior to many "one shop" products. 3000 w. Automobile—Jan. 7, 1905. No. 67054.

Typical American Touring Cars for 1905. Illustrated descriptions of various types. 5700 w. Sci Am—Jan. 28, 1905. No. 67493.

See also Mechanical Engineering, Combustion Motors.

COMBUSTION MOTORS.

Current Practice.

Current Practice in Combustion Engines. Brief illustrated descriptions of the more important features of various engines. 12800 w. Engr, U. S. A.—Jan. 1, 1905. (Special.) No. 67116 D.

Diesel.

The American Diesel Engine. Norman M'Carty. Brief description of the principle on which the engine works. Ills. 1800 w. Engr, U. S. A.—Jan. 1, 1905. (Special.) No. 67117 D.

The Diesel Engine in Electricity Generating Stations. A. J. Lawson. Abstract of a paper read before the Glasgow Tech. College Sci. Soc. Gives the results of actual experience of the working of such engines over a considerable period. 2000 w. Elect'n, Lond—Jan. 13, 1905. No. 67438 A.

Gas Engines.

European Gas Engine Practice. A. H. Allen. Considers the main features of the more recent designs of engines, and also the producer plants. 3000 w. Engr, U. S. A.—Jan. 1, 1905. (Special.) No. 67112 D.

Experience with Large Gas Engines. Abstract of an address by Herr Strack, translated from *Stahl und Eisen*. Describes the gas engines used, and gives an account of their working. 2800 w. Ir Age—Jan. 19, 1905. No. 67270.

Gas Engine Economy. Charles Edward Lucke. The present article is introductory; remarks on the importance of economy. 1200 w. Engr, U. S. A.—Jan. 1, 1905. Serial. 1st part. (Special.) No. 67115 D.

Gas Engines in Power Plants. William T. Magruder. Abstract of a paper read before the Ohio Soc. of Mech., Elec., and Steam Engrs. Arguments for the use of gas engines. 2500 w. Engr, U. S. A.—Jan. 1, 1905. (Special.) No. 67114 D.

Governing Large Gas Engines. Charles S. Sage. Discusses the requirements of a controlling device that will give the best possible efficiency. 4500 w. Power—Jan., 1905. No. 67020 C.

Producer Gas Engines on Shipboard. A. Sinn. An illustrated article discussing the best gas engine practice and its adaptability for use on ships. 3000 w. Marine Engng—Jan., 1905. No. 67031 C.

The Development of the Gas Engine and Its Application to Electric Central Station Service. R. T. MacKeen. Gives a comparative idea of the relative efficiency of steam engines and gas engines, and considers in detail the principle of the gas engine and the gas producer. 3200 w. Can Elec News—Jan., 1905. No. 67400.

The Development of the Gas Engine. Albert Stritmatter. Reviews the history of the development. 2000 w. Engr, U. S. A.—Jan. 1, 1905. (Special.) No. 67111 D.

Gas Power.

See Electrical Engineering, Generating Stations.

Gas Turbine.

The Stolze Gas Turbine Engine. Dr. Alfred Gradenwitz. Particulars of this turbine, with illustrations. 900 w. Autocar—Dec. 31, 1904. No. 67126 A.

Igniters.

Electric Igniters for Gas Engines. George M. Hopkins. An illustrated article showing the principle of the electric igniter. 1200 w. Sci Am Sup—Jan. 7, 1905. No. 67028.

Locomotive.

See Railway Engineering, Motive Power.

Motor Boats.

See Marine and Naval Engineering.

Oil Engines.

Petroleum and Petrol Engines. Illustrates and describes the high-speed vertical engines manufactured by L. Gardner & Sons, Ltd., near Manchester, England. Describes a portable plant. 1500 w. Engr, Lond—Jan. 13, 1905. No. 67459 A.

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Pumps.

See Mech. Engineering, Hydraulics.

Suction Gas.

A General Description of Suction-Gas Plants (Iets over Zuiggas-installatien in het Algemeen). H. A. Ravenek. With illustrations and description of suction gas apparatus, and an account of the installation at Scheveningen. 4500 w. De Ingenieur—Dec. 10, 1904. No. 67350 D.

An Interesting Producer-Gas Plant. Emile Guarini. Brief illustrated description of the Maystre-Ledoyen suction producer-gas plant in Paris. 600 w. Sci Am Sup—Jan. 28, 1905. No. 67498.

Gas Producer Systems. Illustrated detailed descriptions of five or six suction gas producers. 7500 w. Engr, U. S. A. —Jan. 1, 1905. (Special.) No. 67110 D.

Testing.

Gas Engine Testing. H. B. Macfarland. Suggestions for conducting tests, the preparations, running and observation, &c. Ills. 3800 w. Engr, U. S. A.—Jan. 1, 1905. (Special.) No. 67113 D.

See also Mechanical Engineering, Automobiles.

HEATING AND COOLING.

Heating.

Heating and Ventilation. Charles L. Hubbard. Different classes of buildings are described and the apparatus best adapted to each discussed. 3500 w. Am Archt—Jan. 7, 1905. Serial. 1st part. No. 67059.

Hot Water.

The Circulation of Hot Water. John S. Brennan. Read before the Am. Soc. of Heat. & Ven. Engrs. An illustrated explanation of the circulation in radiators of usual and of an improved connection, giving figures of tests of the two styles. 1000 w. Met Work—Jan. 21, 1905. No. 67274.

Hygrometer.

See Mechanical Engineering, Measurement.

Steam Heating.

The Computation of Piping for Low-Pressure Steam Heating (Beitrag zur Berechnung der Dampfleitung von Niederdruckdampfheizungen). F. Gremmels. With especial reference to the loss of pressure for pipes of given diameter and length. Tables and a graphical chart are given. 3000 w. 1 plate. Gesundheits Ingenieur—Jan. 10, 1905. No. 67355 D.

The Return System of Steam Heating (Dampfanlagen nach dem Kreislaufsystem). Bruno Müller. A general account of the arrangement of steam heating systems in which the condensed steam is returned direct to the boiler. 2500 w. Gesundheits Ingenieur—Dec. 20, 1904. No. 67354 D.

Stoves.

The Escape of Gas from Stoves (Gasausstromungen aus Geheizten Oefen). H. Meidinger. An account of experiments with a model upon the conditions which cause the escape of deadly gases from warming stoves. 2500 w. Gesundheits-Ingenieur—Nov. 20, 1904. No. 67352 D.

Ventilation.

Plenum Ventilation Systems (Ueberdruck-Lüftungsanlagen). Richard Hofmann. A brief discussion of the superior economy of the plenum method of ventilating buildings over an exhaust system. 2000 w. Gesundheits-Ingenieur—Nov. 30, 1904. No. 67353 D.

HYDRAULICS.

Chicago Canal.

Water Power Development on the Chicago Drainage Canal. An illustrated article explaining the general scheme. 1400 w. Eng News—Jan. 12, 1905. No. 67151.

Cranes.

Notes on Cranes—Hydraulic Cranes. A. D. Williams. Briefly describes types. 1000 w. Am Mach—Vol. 28, No. 4. No. 67475.

Flume.

Design of a Steel Water Flume. H. G. Balcom. Considers schemes of design for a steel water flume of approximately 450 sq. ft. cross-section and more than 1,000 feet long. General discussion. 4500 w. Pro Engrs' Soc of W Penn—Dec., 1904. No. 67512 D.

Hydro-Electric Stations.

See Electrical Engineering, Generating Stations.

Meters.

See Mechanical Engineering, Measurement.

Pipes.

The Flexure of the Walls of Conduits of Large Diameter (Flexions des Parois dans les Tuyaux de Conduites de Grand Diametre). C. Birault. A study of the external stresses upon the walls of conduits used for conveying water under pressure for hydraulic power stations. 9000 w. 1 plate. Mem Soc Ing Civ de France—Oct., 1904. No. 67358 G.

Plumbing.

Sanitary Plumbing and Our Plumbing Laws, with Suggestions for Their Revision and Simplification. J. Pickering Putnam. An examination of the plumbing ordinances of Boston, which are similar to the majority of large cities in the

United States, and the explanation of a system embodying most of the amendments advocated. Ills. 6000 w. Tech Qr—Dec., 1904. No. 67420 E.

Pumping.

See Civil Engineering, Water Supply.

Pumps.

A Gas Power Pumping Station for High-Pressure Gas Distribution. Illustrated detailed description of the system of the Laclede Gas Light Co., St. Louis, Mo., explaining the principles embodied. 2200 w. Engr, U. S. A.—Jan. 1, 1905. (Special.) No. 67108 D.

A New Type of Rotary Pump. Emile Guarini. Illustrates and describes a pump which is reversible, and yet gives a true piston stroke like an ordinary pump. 600 w. Sci Am Sup—Jan. 28, 1905. No. 67499.

New Motor Pumps on the Riedler Express System. L. Ramakers. Illustrates and describes a new pump which may be driven by electro-motors, and by benzine, gas, spirit, or petroleum motors, or by belting and transmission shafting. 1200 w. Prac Engr—Jan. 13, 1905. No. 67434 A.

The Hesse Jet Pump. Otto Goldman. Illustrates and describes the invention of Prof. James Thompson, giving calculations of efficiency. 1700 w. Cal Jour of Tech—Nov., 1904. No. 67216 C.

Turbine.

The Largest Water Turbine in Existence. Illustrates the large turbine at Shawinigan Falls, near Montreal, giving brief description. 800 w. Sci Am—Jan. 7, 1905. No. 67026.

Water Wheels.

A Novel Water Wheel. Dr. Alfred Gradenwitz. Brief illustrated description of the "hydrovalve," invented by Prof. Frank Kirchbach, and its operation. 800 w. Sci Am—Jan. 14, 1905. No. 67158.

The Development of the Tangential Wheel in California (Die Entwicklung des Tangentialrades in Kalifornien). Heinrich Homberger. A description of the growth of the use of wheels of the Pelton type, including the recent improvements, such as the Doble needle regulator, etc. 3000 w. Zeitschr d Ver Deutscher Ing—Dec. 17, 1904. No. 67300 D.

MACHINE WORKS AND FOUNDRIES.

Bridge Shop.

The Boston Bridge Works. Illustrates and describes briefly the new shops built on the site of the old ones which were destroyed by fire, and gives details of layout. 4500 w. Eng Rec—Jan. 14, 1905. No. 67176.

Car Wheels.

The Manufacture of Cast Iron Car Wheels. An illustrated description of the system and special appliances used at the new plant of the Pennsylvania Railroad at South Altoona, Pa. 4000 w. Ir Age—Jan. 5, 1905. No. 67000.

Castings.

Direct Casting from the Blast Furnace. Illustrates and describes the methods of production of cast iron tunnel segments as pursued at the works of Thomas Butlin & Co., Ltd., Wellingborough, Scotland. 2000 w. Ir Age—Jan. 12, 1905. No. 67073.

Shrinkage Troubles and Methods of "Feeding." Thomas D. West. Read before the New England Found. Assn. Discusses shrinkage and methods of treating it, difficulties in feeding, and methods. 2700 w. Foundry—Jan., 1905. No. 67237.

Cast Iron.

See Mechanical Engineering, Materials.

Chains.

The Manufacture of Chains. L. B. Powell. Illustrated description of the manufacture of machine made, and of hand made chains, the testing, wear, &c. 4500 w. Ir Age—Jan. 5, 1905. No. 67002.

Core Ovens.

Oil as Fuel for Core Ovens. S. F. Barnes. Read before the Phila. Found. Assn. Describes the system of piping employed in using oil as fuel. Ills. 1500 w. Ir Age—Jan. 19, 1905. No. 67269.

Cost Keeping.

See Industrial Economy.

Drills.

Drills and Drill Making (Bohrer und Bohrerfabrikation). G. Niedecker. A discussion of the action of flat and twist drills, with suggestions as to the best forms and processes of manufacture. Three articles. 4000 w. Zeitschr f Werkzeugmach u Werkzeuge—Nov. 25, Dec. 5, 15, 1904. No. 67395 each D.

Electric Driving.

See Electrical Engineering, Motors.

Engine Building.

A Modern Engine Building Plant. Illustrated description of the large plant of the William Tod Company, at Youngstown, Ohio. 2300 w. Ir Age—Jan. 5, 1905. No. 67006.

Forging.

Forging Machinery. Jas. H. Baker. Considers hammers, forging rolls and presses. General discussion. 8000 w. Pro Engrs Club of W Penn—Dec., 1904. No. 67513 D.

Improved Forging Machinery (Neuere Schmiedemaschinen). P. Möller. De-

scribing small screw forging presses, bolt machines, screw-thread rolling machines, etc., built by Hasenclever, of Düsseldorf. 2500 w. Zeitschr d Ver Deutscher Ing—Jan. 7, 1905. No. 67305 D.

Foundry.

Steel Foundry of the Wellman-Seaver-Morgan Engineering Company, Cleveland, O. Illustrates and describes the equipment of this foundry, which is modern in every respect. 1500 w. Foundry—Jan., 1905. No. 67232.

Gear Cutters.

Wheel Cutting Machines. Thomas R. Shaw. Illustrates and describes wheel-cutting machines of various types, explaining their working. 3300 w. Mech Engr—Dec. 31, 1904. Serial. 1st part. No. 67127 A.

Glass Bearings.

Glass Bearings and Modern Machinery. An illustrated outline of the process of making these bearings for both experimental and practical purposes. 1200 w. Mod Mach—Jan., 1905. No. 67053.

Heavy Work.

Heavy Work of the Port Richmond Iron Works. From a bulletin recently issued by the I. P. Morris Co. An illustrated account of recent engineering construction. Turbines, centrifugal pumps, &c. 1600 w. Mach, N. Y.—Jan., 1905. No. 66987 C.

Lead Pipe.

The Theory and Practice of Compression Machines for Making Lead Pipe (Teoria e Pratica delle Macchine a Compressione per Tubi di Piombo). Ernesto Ascione. A complete study of the flow of metals as applied to the production of lead pipe by forcing the metal through dies. 7 articles. 12000 w. L'Industria—Nov. 13, 20, 27, Dec. 4, 11, 18, 25, 1904. No. 67392 each D.

Melting.

Meting with the Air Furnace. Dr. R. Moldenke. States the advantage to be derived from the use of the air furnace, describing typical designs in use in Europe and in America. Ills. 1800 w. Am Mach—Vol. 28, No. 1. No. 67039.

Molding Machines.

Molding Machines and Their Uses. E. H. Mumford. Read before the A. F. A. Calls attention to some of the simpler machines and their use. 2000 w. Foundry—Jan., 1905. No. 67233.

Molding Machines of To-Day. Herbert M. Ramp. Read before the A. F. A. Discusses the developments in molding machines over those of a decade ago. 1600 w. Foundry—Jan., 1905. No. 67234.

Molding Machine Practice. F. W. Hall. Illustrates and describes the molding of a cone pulley 5 inches in diameter. 2500 w. Foundry—Jan., 1905. No. 67235.

Rolling Mills.

See Mining and Metallurgy, Iron and Steel.

Screw Hoists.

Notes on Cranes—A Screw Hoist. A. D. Williams. Describes screw hoists, giving sketch of screw and driving connections for a 60-ton hoist. 600 w. Am Mach—Vol. 28, No. 1. No. 67038.

Shops.

The New Works of the Fiberloid Company, at Springfield, Mass. Illustrated description of a fireproof plant comprising twenty buildings, equipped with electric drivers, two steam distribution systems, automatic sprinklers on both wet and dry systems, large water filters, incandescent electric lights and up-to-date plumbing. 3000 w. Eng Rec—Jan. 28, 1905. Serial. 1st part. No. 67521.

Messrs. Schneider and Co.s New Electricity Works. Brief description, with illustrations, of the new electric construction works near Fontainebleau. 900 w. Engng—Dec. 31, 1904. No. 67136 A.

See Railway Engineering, Permanent Way and Buildings.

Small Tools.

Care and Control of the Small-Tool Equipment in the Shop. R. Emerson. Discussing systems for the inspection, repair, and maintenance of small-tool kits, with forms from practical service for maintaining control of such supplies issued to workmen. 3500 w. Engineering Magazine—Feb., 1905. No. 67509 B.

Steel Castings.

Defects in Steel Castings (Gussfehler an Stahlgussstucken). Paul Friem. An examination of the causes for the production of cracks, blowholes, and other flaws, and methods for their prevention. 4500 w. Stahl u Eisen—Jan. 1, 1904. No. 67345 D.

Turret Lathes.

Combination Turret Lathe. Illustrated detailed description of a machine used in the manufacture of the various parts of the gear mechanism in motor cars. 1500 w. Engng—Dec. 30, 1904. No. 67140 A.

The Automatic versus the Hand Turret Lathe. Paul Wesley. Gives experience with automatic machines, and describes the method of handling the work on hand and in automatic machines. 1600 w. Am Mach—Vol. 28, No. 4. No. 67474.

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MATERIALS OF CONSTRUCTION.

Bower-Barff.

The Inoxidising Furnace (Der Inoxydationsofen). G. Weigelin. Describing the form of regenerative gas furnace used for producing the so-called Bower-Barff coating of rustless magnetic oxide upon articles of iron. 1800 w. Stahl u Eisen —Dec. 15, 1904. No. 67349 D.

Brittleness.

The Brittleness of Certain Steels (Sur la Fragilité de Certains Aciers). MM. A. Perot & H. M. Levy. A note showing the influence of the speed of drop tests upon the indications as to brittleness. 700 w. Comptes Rendus—Dec. 26, 1904. No. 67323 D.

Bronzes.

Physical Characteristics of Certain Bronzes for Steam Use. Strickland L. Kneass. Discusses the essential characteristics of good steam metals, the deteriorating agencies to which they are subject, and the value of the microscope and testing-machine in determining quality. General discussion. 3800 w. Jour Fr Inst —Jan., 1905. No. 67248 D.

Cast Iron.

The Economic Value of Cast Iron. W. H. Pretty. Abstract of a paper read before the Manchester (Eng.) Assn. of Engrs. Considers the most important applications of cast iron, the things that affect the product, the cost, &c. 2200 w. Prac Engr—Dec. 23, 1904. Serial. 1st part. No. 66995 A.

Deformation.

The Behaviour of Materials of Construction without Elastic Limits (Ueber das Verhalten von Konstruktionsmaterialien ohne Proportionsgrenze). Bernh. Kirsch. A review of the experiments of Bach and of Berner showing the nature of yielding beyond the elastic limit. 1800 w. Zeitschr d Oesterr Ing u Arch Ver—Dec. 16, 1904. No. 67332 D.

Lubricants.

A New Process of Testing Lubricating Oils. Emile Guarini. Illustrated description of an instrument for testing lubricating oils by means of their internal electrical resistance. 900 w. Sci Am Sup—Jan. 14, 1905. No. 67160.

Electrical Investigations of Lubricants (Ueber Elektrische Schmiermitteluntersuchungen). A. Boje. Describing apparatus for measuring frictional resistance, rise of temperature, etc., as applied to lubricants, with tables and diagrams of results. Two articles. 3500 w. Elektrotech u Polytech Rundschau—Dec. 15, 1904, Jan. 15, 1905. No. 67394 each B.

Notes on Safety-Lamp Oils. Dr. G. P. Lishman. Read before the N. of Eng. Inst. of Min. & Mech. Engrs. Considers of what a good safety-lamp oil consists and what it ought to cost. 1200 w. Col Guard—Dec. 30, 1904. No. 67134 A.

Oils for Motor Cars. C. Simmonds. Information concerning the oils in use at the present time as fuels for motors. 2400 w. Nature—Dec. 29, 1904. No. 67118 A.

Steam Cylinder Lubrication. Charles E. Carpenter. A talk on this subject giving general rules and discussing oils and their troubles. 6500 w. Power—Jan., 1905. No. 67023 C.

Testing Cylinder Oils. M. Emile Lecocq, in *Le Journal de Petrole.* Suggests a method of analysis for the examination of lubricating oils. 1800 w. Am Gas Lgt Jour—Jan. 23, 1905. No. 67401.

The Purification of Waste Lubricating Oil. F. H. Davies. Illustrates and describes various types of oil fillers, and other methods of purification. 1800 w. Elec Engr, Lond—Jan. 13, 1905. No. 67442 A.

Testing.

Modes of Testing Castings. W. T. Maccall. Abstract of a paper read before the British Found. Assn. Brief account of tests applied to castings of iron, steel, brass, gun metal, bronze, &c. 1800 w. Mech Engr—Jan. 7, 1905. No. 67192 A.

Punching Considered as a Method of Testing (Le Poinçonnage Envisagé comme Méthode d'Essai). L. Baclé. An examination of the use of measurements of the resistance to punching as an indication of the strength of the material. 3500 w. Bull Soc d'Encour—Nov. 30, 1904. No. 67340 G.

Vanadium Steel.

Researches upon Vanadium Steels (Recherches sur les Aciers au Vanadium). Léon Guillet. A continuation of the author's investigations, with especial reference to the influence of vanadium to steels containing nickel. Serial. Part I. 2000 w. Génie Civil—Jan. 7, 1905. No. 67315 D.

MEASUREMENT.

Blower Tests.

Fan and Positive Pressure Blower Tests. H. E. Field. A report of tests made at Ft. Pitt foundry, Pittsburg. 4000 w. Foundry—Jan., 1905. No. 67238.

Calorimetry.

Calorimetry. John F. Simmance. Shows the value of calorimetry and the method of determining the heating value of gases by the calorimeter, with examples. Ill.

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3500 w. Engng—Jan. 13, 1905. No. 67454 A.

Hardness.

Researches on the Comparative Hardness of Acid and Basic Open-Hearth Steel at Various Temperatures, by Means of "Ball-Testing." J. A. Brinell. Brief report of tests, stating results. 600 w. Ir & Steel Mag—Jan., 1905. No. 67255 D.

Hygrometer.

Investigation of Accuracy of a Direct-Reading Hygrometer. R. C. Carpenter. Read before the Am. Soc. of Heat. & Ven. Engrs. Description and investigation of two hygrometers of German make which are said to be within 5 per cent. of correct. Ills. 2500 w. Met Work—Jan. 21, 1905. No. 67273.

Metric System.

The Metric System of Weights and Measures. A. E. Kennelly. Favoring the adoption of the metric system. 4800 w. Pop Sci M—Feb., 1905. No. 67472 C.

Pyrometer.

The Pyrometer in Blast Furnace Practice. S. H. Stupakoff. Read before the Pittsburg Found. Assn. Brief illustrated descriptions of the principal instruments used. 2200 w. Ir Trd Rev—Jan. 5, 1900. No. 67029.

Speed Indicator.

A Centrifugal Speed Indicator (Note sur un Compteur de Vitesse à Force Centrifuge). J. Carlier. A device employing the action of a centrifugal ball-governor to indicate the speed of a machine at any instant. Two articles. 2500 w. Revue Industrielle—Dec. 3, 17, 1904. No. 67393 each D.

Water Meters.

The Measurement of Water (Sui Contatori d'Acqua). Elia Ovazza. A discussion of the principles involved in various forms of water meters, and details of their construction. Three articles. 6000 w. Il Monitore Tecnico—Nov. 10, 20, 30, 1904. No. 67396 each D.

POWER AND TRANSMISSION.

Compressed Air.

Internal Reheating of Compressed Air. C. A. Dawley and A. W. Stone. Discusses methods of reheating, explaining the theory of dry reheating, and of wet heating, and examining some heaters. Ills. 4000 w. Sib Jour of Engng—Jan., 1905. Serial. 1st part. No. 67252 C.

The Compressed Air Power Plants for the Pennsylvania Railroad Tunnels, New York. Brief outline of the plants for the work of constructing tunnels under the North and East Rivers, at New York City. 1000 w. Eng Rec—Jan. 28, 1905. No. 67523.

Three-Stage Air Compressor (Dreistufiger Luftkompressor). Julius Divis. Describing a convenient portable air compressor for mining use. 1800 w. 1 plate. Oesterr Zeitschr f Berg u Hüttenwesen—Dec. 3, 1904. No. 67376 D.

Conveyors.

Coal and Ash Conveying Machinery for Power Plants. Brief illustrated descriptions of many types. 10200 w. Engr, U. S. A.—Jan. 1, 1905. (Special.) No. 67109 D.

The Belt Conveyor as an Elevator. An explanation of the use made of belt conveyors in the Transvaal, giving information in regard to efficiency, horse-power, &c. 2000 w. Engr, Lond—Jan. 13, 1905. No. 67457 A.

The Coal-Handling Plant of the Power-House of the Interborough Rapid Transit Company. Illustrated description of the Robins system, installed to handle coal and ashes at this plant in New York City. 900 w. Elec Rev, N. Y.—Dec. 31, 1904. No. 66982.

Gearing.

Bevel Gear Calculations. J. H. Wright. Describes a method which makes necessary only one reference to a table of tangents. 400 w. Am Mach—Vol. 28, No. 3. No. 67272.

Strength of Gear Teeth. Frank B. Kleinhans. Gives tables calculated by the slide rule, with explanation of their use. 1200 w. Engr, U. S. A.—Jan. 16, 1905. No. 67279 C.

Test of Rough Gray-Iron Spur Gears. W. M. Wilson. An illustrated account of tests made under different conditions of speed and load with the purpose of determining the effect of these different conditions upon the efficiency. 1700 w. Am Mach—Vol. 28, No. 2. No. 67098.

Lubrication.

See Mechanical Engineering, Materials.

Power Plant.

The Mechanical Equipment of the Bellevue-Stratford Hotel, Philadelphia. Begins an illustrated detailed description of a very extensive mechanical plant for hotel service. 3000 w. Eng Rec—Dec. 31, 1904. Serial. 1st part. No. 66960.

See Mechanical Engineering, Hydrau-

The Plant of the Murphy Power Building. Illustrated description of the plant for a Detroit building which furnishes power for all kinds of manufacturing and industrial purposes, an office building, and a central district heating plant. 2500 w. Engr, U. S. A.—Jan. 16, 1905. No. 67278 C.

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Speed Gear.

See Mechanical Engineering, Automobiles.

Tidal Power.

Tidal Power Schemes. Gives a résumé of tidal schemes projected or actually carried into practice, with deductions. 2000 w. Engr, Lond—Jan. 13, 1905. Serial. 1st part. No. 67455 A.

Water v. Steam.

Water-Power v. Steam-Power in the British Isles. E. Ristori. Discusses the economical possibilities in Great Britain for the development of hydro-electric plants, comparing with steam plants. 4000 w. Engng—Dec. 23, 1904. No. 67014 A.

STEAM ENGINEERING.

Boilers.

Unequal Temperature Effects in Boilers—Causes of Ripping, Grooving, Pitting, &c. W. H. Booth. Discusses expansion effects discovered in the inspection of boilers. 1200 w. Power—Jan., 1905. No. 67021 C.

Condensing.

Condensing Machinery. William Edward Storey. Read before the Society of Engineers. Illustrates and describes the various types of condensers, tracing the development. 2300 w. Mech Engr—Dec. 24, 1904. Serial. 1st part. No. 67011 A.

Cooling Towers.

Devices for Cooling Condensing Water (Rückkühlwerke). Otto H. Mueller. A description of various forms of cooling towers and other devices for extracting the heat from condensing water in order that it may be used again. Serial. Part I. 5000 w. Zeitschr d Ver Deutscher Ing—Jan. 7, 1905. No. 67304 D.

Engines.

Engines of H. M. S. Black Prince. Illustrated detailed description of the propelling engines, of the inverted-cylinder twin-screw type. 2200 w. Engr, Lond—Dec. 30, 1904. No. 67144 A.

The Machinery of H. M. S. "Argyll." Illustration, with description of the twin engines of this armored cruiser. Also briefly describes the vessel and its equipment, the machinery, &c. 2400 w. Engng—Jan. 13, 1905. No. 67451 A.

Feed Pumps.

Some Notes on High-Speed Feed Pumps and the Reasons of Their Inefficiency. E. C. Barton. Read before the Queensland Inst. Gives calculations made in comparing the relative advantages of a Worthington and a Weir pump. 1700 w. Elec Engr—Jan. 13, 1905. No. 67443 A.

Feed Water.

Boiler Scale and Boiler Feed. Harry Spurrier. A study of water, its solvent action, the effect, &c. 2500 w. Can Engr—Jan., 1905. No. 67150.

Water Softening. G. M. Campbell. Control and results from a chemical standpoint, based largely on experience with the plants on the Pittsburgh and Lake Erie Railroad. 2000 w. Am Engr & R R Jour—Jan., 1905. Serial. 1st part. No. 66993 C.

Fuels.

Fuel Testing. An illustrated description of the plant of the United States Geological Survey at the Louisiana Purchase Exposition. 6600 w. Mines & Min—Jan., 1905. No. 67077 C.

The Economy of Small Size Coal for the Power Plant. Percival Robert Moses. A discussion of the conditions under which buckwheat coal and other low-grade fuels can be advantageously used for steam making. 3500 w. Engineering Magazine—Feb., 1905. No. 67506 B.

The Value of the Flame of Combustibles. P. Mahler. Translated from the *Revue Universelle des Mines.* A comparison of different coals on the basis of the temperature of combustion; also of other combustibles. 2700 w. Jour Fr Inst—Jan., 1905. No. 67245 D.

Lubrication.

See Mechanical Engineering, Materials.

Smoke.

The Smoke Problem (Die Rauchfrage). F. Haier. A discussion of the relation of smoke production to fuel economy, together with the best methods of reducing the evolution of smoke in boiler firing; data from experimental investigations. Serial. Part I. 5000 w. Zeitschr d Ver Deutscher Ing—Jan. 7, 1905. No. 67306 D.

Steam Pipes.

Concerning Pipe Threads. A supplementary article to two others on this subject, giving further facts in relation to pipe threads. Ills. 4000 w. Locomotive—Jan., 1905. No. 67231.

Pipe Joints, Gaskets and Leaks. R. T. Strohm. Suggests a number of ways of securing tight joints. Ills. 2000 w. Am Elect'n—Jan., 1905. No. 67037.

Steam-Pipes. F. H. Davies. Discusses recent practice in steam-pipe work and changes due to increase in steam pressures. 2700 w. Elec Engr, Lond—Dec. 23, 1904. No. 67010 A.

Steam Turbines.

Description of Well-Known Types of Steam Turbines with Special Reference to

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the Westinghouse-Parsons. R. N. Ehrhart. Considers the different types of turbines now in use, giving illustrations and reports of tests. 4500 w. Pro Engrs Soc of W Penn—Nov., 1904. No. 67242 D.

Efficiency Test of a Direct-Connected Steam Turbine Fan Blower Set. C. R. Waller. Illustrates and describes a test made recently at the testing-room of the De Laval Steam Turbine Co., Trenton, N. J., giving report of tests. 1800 w. Eng News—Jan. 19, 1905. No. 67287.

Practical Data on European Practice with Steam Turbines. Franz Koester. Illustrations of types used, with notes. 1000 w. Eng Rec—Jan. 7, 1905. No. 67067.

The Compound Steam Turbine. Aims to show that if the over-all internal efficiency is known, the frictional loss in each stage can be deduced, and if the total frictional losses per stage are determined, and the bucket speed, the losses can be divided between the guide-blades and the buckets. 5000 w. Engng—Jan. 13, 1905. Serial. 1st part. No. 67447 A.

The Electra Steam Turbine. Walter Rappaport. Brief illustrated description of the method of working. 500 w. Elec Rev, Lond—Jan. 13, 1905. No. 67436 A.

Superheater.

The Schmidt Smoke-Tube Steam Superheater. Illustrates and describes a new form recently brought out. 1100 w. Engng—Dec. 23, 1904. No. 67017 A.

Valves.

The Design of Drop Valves. Concerning the angle of seat employed, with calculations for the correct radii and angles. Ills. 1100 w. Engr, Lond—Jan. 6, 1905. No. 67205 A.

MISCELLANY.

Aeronautics.

The Stability of Dirigible Balloons (Sur la Stabilité des Dirigeables). G. A. Crocco. A mathematical examination of the different conditions of stability of a balloon when at rest and in motion. 800 w. Comptes Rendus—Dec. 26, 1904. No. 67322 D.

Liquid Air.

Commercial Possibilities of Liquid Air. A theoretical consideration of the principles involved and the energyv absorbed by its production and subsequently set free by its volatilization. 2000 w. Engr, Lond—Dec., 23, 1904. No. 67018 A.

MINING AND METALLURGY

COAL AND COKE.

Alabama.

The Pratt Coal Mines in Alabama. W. R. Crane. Information concerning the production of coal in Alabama, its character, quality, etc., with illustrated description of the Pratt mines and methods of mining. 3500 w. Eng & Min Jour—Jan. 26, 1905. No. 67516.

Anthracite.

The Preparation of Anthracite in the Schuylkill Region of Pennsylvania. Illustrates and describes the methods and machinery employed at the Hammond breaker, near Shenandoah. 2000 w. Mines & Min—Jan., 1905. No. 67078 C.

Briquetting.

On Coal Briquetting. Dr. Alfred Gradenwitz. Explains the three types of presses in use, illustrating machines and describing the method of work. 1700 w. Min Rept—Dec. 29, 1904. No. 66976.

Canada.

Canada's Fuel. On the location of the coal fields, character of the deposits, quantity mined and consumed, etc. 1500 w. Engr, Lond—Jan. 13, 1905. No. 67458 A.

China.

Chinese Coal Developments. Information concerning these extensive deposits, their value and extent, and the development which is to be made possible by the approaching completion of the railway to Taokou. 1600 w. Engng—Dec. 30, 1904. No. 67141 A.

Coal Production.

Coal Mining and Production for the Year 1904. Samuel Sanford. A general review of the year, with statistics of interest. Maps. 4200 w. Min Wld—Jan. 21, 1905 (Special). No. 67411 C.

Coke.

By-Product Foundry Coke. Charles Schwerin. Read before the A. F. A. Remarks on the process of its manufacture and its utilization, particularly for cupola purposes. 2000 w. Foundry—Jan., 1905. No. 67236.

Colorado.

The Coal Fields of Colorado. A. Lakes. The present article gives an illustrated description of the South Platte or northern

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liquitic coal field, the Louisville coal basin, and the Marshall coal field. 1200 w. Min Rept—Jan. 19, 1905. No. 67415.

Montana.

Coal in Montana. Briefly describes the mines of this region, reporting the development. 2800 w. Min & Sci Pr—Dec. 24, 1904. Serial, 1st part. No. 66975.

Rocky Mountains.

The Rocky Mountain Coal Fields. A. Lakes. An account of these fields, with maps. 1400 w. Min Rept—Jan. 5, 1905. No. 67056.

South Wales.

The Situation and the Outlook in the South Wales Coal Industry. Written under direction of D. A. Thomas. Considers briefly wages, trade, prices, profits, etc. 4000 w. Ir & Coal Trds Rev—Dec. 30, 1904. No. 67145 A.

Storage Plant.

The Largest Coal Storage Plant in the World. An illustrated description of the new plant of the Philadelphia & Reading Coal & Iron Company under construction at Abrams, Pa. It will have a capacity of 500,000 tons. 3000 w. Ir Age—Jan. 5, 1905. No. 67005.

Texas.

The Coal, Lignite and Asphalt Rocks of Texas. Dr. W. B. Phillips. Much information is given concerning these deposits, mining operations, cost of transportation, etc. General discussion. 8000 w. Jour W Soc of Engrs—Dec., 1904. No. 67256 D.

Welsh Coal.

Reserves of Welsh Smokeless Steam Coal for the British Navy. W. H. Renwick. Discusses the schemes for curtailing the export of this coal, with the object of conserving it for future naval requirements. 4500 w. Nineteenth Cent—Jan., 1905. No. 67211 D.

COPPER.

Analysis.

Some Experiences of an Analyst. Dr. J. Ohly. A report of the analysis of some copper ores, showing that the fire assay was very reliable in the three cases investigated. 1500 w. Min Rept—Jan. 5, 1905. No. 67057.

Arizona.

The United Verde Copper Mine. Dwight E. Woodbridge. An illustrated description of this valuable property in Central Arizona. 2000 w. Ir Age—Jan. 12, 1905. No. 67074.

British Columbia.

Copper Mountain, British Columbia. Jules Catherinet. An illustrated article dealing with the genesis of these ores and with their alteration, based chiefly on microscopic study. 2800 w. Eng & Min Jour—Jan. 19, 1905. No. 67275.

Copper.

Copper. Frederick Hobart. Gives an estimate concerning exports and imports, etc. 2300 w. Eng & Min Jour—Jan. 5, 1905. No. 67082.

Copper Trade.

See Industrial Economy.

Cuba.

Copper Mines Near Havana, Cuba. Walter Harvey Weed. Brief description of the Minas district, with illustration. 1500 w. Eng & Min Jour—Jan. 26, 1905. No. 67515.

Lake Superior.

Lake Superior Copper. C. E. L. Thomas. Reports a highly successful year, giving general information. 2500 w. Eng & Min Jour—Jan. 5, 1905. No. 67083.

Queensland.

The Cloncurry Copper Field. Thomas Gibb. A special report on its ores. 4800 w. Queens Gov Min Jour—Nov. 15, 1904. No. 67121 B.

The O. K. Copper Mine. Thomas Gibb. A report of this mine, with illustrations. 2000 w. Queens Gov Min Jour—Nov. 15, 1905. No. 67122 B.

Review.

Annual Review of the Copper Industry for 1904. Horace J. Stevens. Reviews the American production, and the world's production. 6800 w. Min Wld—Jan. 21, 1905 (Special). No. 67413 C.

Eleventh Annual Review of the Lake Superior Copper Industry. Horace J. Stevens. A review of one of the best years ever known as regards production. 1500 w. Min Rept—Jan. 5, 1905. No. 67058.

GOLD AND SILVER.

Alaska.

Alaska. Alfred H. Brooks. A review of the output for the past year, with general information of the mining industry. Map. 2600 w. Eng & Min Jour—Jan. 5, 1905. No. 67085.

Forty Mile, Alaska. J. S. French. An account of mining methods and life in the Yukon basin. Ills. 3700 w. Min & Sci Pr—Dec. 24, 1904. No. 66974.

Alluvial Gold.

The Saving of Alluvial Gold in Alaska and the Klondike. Chester Wells Purington. Notes on sluices and gold-saving appliances from a forthcoming report of the

U. S. Geological Survey. Ills. 2700 w. Min Mag—Jan., 1905. No. 67226 C.

Bolivia.

Mining in Bolivia. D. H. Bradley, Jr. Considers the deposits of silver, gold, copper and tin, the methods of mining, etc. Ills. 1800 w. Min Mag—Jan., 1905. No. 67229 C.

British Columbia.

The Centre Star Mine. L. Heber Cole. Abstract of a paper read before the Min. Sec. of the Canadian Soc. of Civ. Engrs. Illustrates and describes the methods of mining, machinery used, etc., of this mine at Rossland, B. C. The mine consists of iron and copper sulphides. The principal value is in gold carried chiefly by the chalcopyrite. 5000 w. Can Min Rev—Jan., 1905. No. 67514 B.

Cripple Creek.

Report of Progress in the Geological Resurvey of the Cripple Creek District, Colorado. Waldemar Lindgren and Frederick Leslie Ransome. 9000 w. Min Wld —Jan. 14, 1905. No. 67184.

Crushing.

Note on the Influence of Fine Crushing on the Assay Value. A. Whitby. A report of the result of experiments, with short discussion. 1100 w. Jour Chem, Met & Min Soc of S Africa—Oct., 1904. No. 67050 E.

Cyanidation.

Cyanidation in United States. Charles H. Fulton. Reviews the progress, noting experiments made which promise improvements, the increased application, etc. 3700 w. Eng & Min Jour—Jan. 5, 1905. No. 67087.

Deep Leads.

The Deep Leads of Victoria, Australia. Waldemar Lindgren. An illustrated description of the region of its geology and the auriferous character of the leads. 2800 w. Min Mag—Jan., 1905. Serial. 1st part. No. 67228 C.

Dredging.

Gold Dredging and Prospecting. Robert H. Postlethwaite. A short illustrated review of this industry under existing conditions. 4000 w. Min Mag—Jan., 1905. No. 67225 C.

Extraction.

The Use of Electro-Plated Copper Plates in the Battery. F. W. Cindel. Remarks on the system of plates, and the percentage of extraction, with brief discussion. 2300 w. Jour Chem, Met & Min Soc of S Africa—Oct., 1904. No. 67049 E.

French Guiana.

Gold Mining in French Guiana. David E. Headley. An illustrated account of the industry, and of the regulations which allow no one but a surveyor to mark boundaries, and so deprive the poor miner of his opportunity. 1600 w. Eng & Min Jour —Jan. 19, 1905. No. 67277.

Kalgoorlie.

Wet Ball Mills v. Stamper Batteries. A comparison, with special reference to conditions in the Kalgoorlie gold field. Ills. 1400 w. Aust Min Stand—Dec. 15, 1904. No. 67489 B.

Klondike.

The Klondike. J. P. Hutchins. Reports the production as amounting to $1,000,000 less than in 1903, and reviews the work done, the mining methods, etc. 1500 w. Eng & Min Jour—Jan. 5, 1905. No. 67086.

Metallurgical Progress.

Metallurgical Progress in Africa and Australia. Alfred James. Reports concerning the stimulus to regrinding due to H. S. Denny's work, residue treatment, etc. 2800 w. Eng & Min Jour—Jan. 5, 1905. No. 67088.

Mexico.

Mexico. James W. Malcolmson. A review of the districts, showing great prosperity, especially in the production of silver and copper. Map. 3000 w. Eng & Min Jour—Jan. 5, 1905. No. 67089.

Nevada.

Goldfield, Nevada. R. G. Dill. An illustrated report of this district, which has produced $5,000,000 gold during the first twelve months since its discovery. 3200 w. Ores & Metals—Jan. 1, 1905. No. 67024.

Peru.

Gold and Copper Mining in Peru. Enrique Laroza. An illustrated description of the region, its deposits of value, especially gold and copper, the methods of mining, extraction, etc. 3000 w. Min Mag —Jan., 1905. No. 67230 C.

Placers.

The Porcupine Placer District, Alaska. Charles W. Wright. From the U. S. Geol. Survey. An illustrated description of this district in Southeastern Alaska. 2400 w. Min & Sci Pr—Jan. 14, 1905. No. 67298.

Production.

The Production of Gold and Silver in the United States. T. A. Rickard. Statistics and general review of the past year. 1800 w. Eng & Min Jour—Jan. 5, 1905. No. 67080.

The World's Gold Production. T. A. Rickard. Reports an increase in the gold output, reviewing the principal gold-yielding districts. 2300 w. Eng & Min Jour—Jan. 5, 1905. No. 67081.

We supply copies of these articles. See page 1038.

Silver Ledge.

The Silver Ledge Mill. W. G. Swart. Illustrated detailed description of a mine and mill in Colorado. The ore consists of galena, blende and pyrite, with a little chalcopyrite. 2000 w. Min Rept—Jan. 19, 1905. No. 67414.

Smelting.

The Preparation of Fine Material for Smelting. T. J. Greenway. Describes a briquetting process used at the works of The Broken Hill Proprietary Block 14. 1400 w. Eng & Min Jour—Jan. 12, 1905. No. 67199.

South Africa.

Exhaustion of Outcrop Mines in the Transvaal. J. H. Curle, in *The Economist*, London. Discusses the rapid exhaustion of these mines, claiming that many will not last six years. 1200 w. Eng & Min Jour—Jan. 26, 1905. No. 67517.

Notes on Crushing of Metalliferous Ores in the Stamp Battery in Africa. F. O. Roberts. An account of extraction methods in Africa, and the use of the stamp mill as a crushing machine. 1100 w. Min & Sci Pr—Dec. 24, 1904. Serial. 1st part. No. 66973.

Petrography of Witwatersrand Conglomerates with Special Reference to the Origin of the Gold. Drs. Hatch and Corstorphine. Describes the microscopic characters of sections of banket, and examines the theories presented to explain the presence of gold, favoring the theory of subsequent infiltration. 3000 w. Min Jour —Jan. 7, 1905. No. 67188 A.

Kimberley Notes. T. Lane Carter. Information of interest in regard to conditions at these diamond mines, the growing use of electricity, working costs, etc. 1600 w. Eng & Min Jour—Jan. 19, 1905. No. 67276.

The Transvaal. W. Fischer Wilkinson. Reports the gold production for the year to be about $78,000,000, and gives a review of the important events affecting the mining industry in this field. 1800 w. Eng & Min Jour—Jan. 5, 1905. No. 67090.

Sulphide Ores.

Electricity as an Agent in Treating Sulphide Ores. M. Vaygouny. Describes a series of experiments made by the writer and gives the results. 4300 w. Cal Jour of Tech—Nov., 1904. No. 67213 C.

IRON AND STEEL.

Blast Furnaces.

Stock Distribution in the Blast Furnace. Jos. E. Raysor and John J. Porter. Discusses troubles that arise and their causes, and illustrates some filling devices. 1700 w. Ir Age—Jan. 12, 1905. No. 67076.

The Theory of Carbon-Deposition in the Blast Furnace. A. D. Elbero. An explanation of a new theory. 2000 w. Am Mfr & Ir Wld—Dec. 29, 1904. No. 66957.

Blowing Engines.

Blast-Furnace Vertical Blowing-Engines. Illustrated detailed description of new blowing-engines at the North-Eastern Steel Company's works, England. 1700 w. Engng—Jan. 6, 1905. No. 67203 A.

Cast Iron.

See Mechanical Engineering, Materials.

Dry-Air Blast.

The Drying of Furnace Blast by Refrigeration (Trocknung des Hochofenwindesmittels Kältemaschinen). Dr. C. von Linde. A discussion of the Gayley process for drying the air supplied to blast furnaces, with an estimate of the cost of the operation. 4000 w. Stahl u Eisen—Jan. 1, 1905. No. 67342 D.

Electric Smelting.

See Electrical Engineering, Electrochemistry.

Iron Trade.

See Industrial Economy.

Ladle Car.

Twenty-Ton Electric Ladle Car (Elektrisch Betriebener Giesswagen für 20 Tonnen Pfanneninhalt). With photographs showing construction and details for conveying and pouring from the ladle. 1200 w. Stahl u Eisen—Dec. 15, 1904. No. 67348 D.

Lake Superior.

Developments in Lake Superior Iron Mining. Kirby Thomas. A review of the past year, giving chart showing fluctuations in iron and steel prices from 1895 to 1904. 2100 w. Min Wld—Jan. 21, 1905 (Special). No. 67412 C.

The Lake Superior Iron Ranges. Dwight E. Woodbridge. A review of the progress of the Lake Superior ore trade for 1904. 2000 w. Eng & Min Jour—Jan. 5, 1905. No. 67092.

Low Steel.

The Production of Low Steel in the Open Hearth Furnace (Mitteilungen über die Flusseisendarstellung im Siemens-Martinofen). H. Gensmer. A review of recent progress in the production of open-hearth steel, showing the developments of the past ten years. 6000 w. Stahl u Eisen —Dec. 15, 1904. No. 67346 D.

Mesabi.

The Mesabi Iron Ore Range. Dwight E. Woodbridge. Begins a history of this important district. Ills. 2000 w. Eng & Min Jour—Jan. 12, 1905. Serial. 1st part. No. 67200.

We supply copies of these articles. See page 1038.

Metallurgy.

An Introductory Outline of the Metallurgy of Iron and Steel. Albert Sauveur. From advanced sheets of a work soon to be published. Considers the conditions which must be fulfilled to extract metallic iron from ores, and the chemical and physical principles involved. 4400 w. Ir & Steel Mag—Jan., 1905. No. 67254 D.

Ore Handling.

Improved Handling Machinery (Neue Verladevorrichtungen). H. S. Johannsen. An illustrated description of the improved machinery used in America for excavating and handling iron ore. Serial. Part I. 3500 w. 1 plate. Stahl u Eisen—Jan. 1, 1905. No. 67343 D.

Reheating.

The Garrett Reheating Furnaces. J. S. Trinham. Read before the Staffordshire Ir. & Steel Inst. An illustrated description of this furnace, describing also other types, and explaining its working and advantages. 3800 w. Ir & Coal Trds Rev—Dec. 30, 1904. No. 67148 A.

Rolling Mills.

Plans for Modernizing Antiquated Rolling Mills (Vorschläge zur Modernisierung Veralteter Walzwerksanlage). H. Hübers. With plans of changes and estimates of cost of change compared with economy effected. 2500 w. Stahl u Eisen—Jan. 1, 1905. No. 67344 D.

Rolls for Uneven Angles. William Hirst. Describes the operation of rolling angular sections, illustrating by examples. 3000 w. Ir Age—Jan. 12, 1905. Serial. 1st part. No. 67075.

Wire-Rod and Bar Rolling-Mill Plants. Engravings and particulars of work from a German plant. 1000 w. Engng—Dec. 23, 1904. No. 67501 A.

Roll Turning. W. S. Standiford. Describes the roll lathe and tools for roll turning, roll turners' troubles, etc. 3500 w. Am Mach—Vol. 28, No. 4. No. 67476.

Steel Castings.

See Mechanical Engineering, Machine Works and Foundries.

MINING.

Brazil.

Mining and Hydraulic Engineering in Brazil. William Maude. An illustrated account of the novel conditions under which old placers have been reopened. 4000 w. Engineering Magazine—Feb., 1905. No. 67508 B.

Canada.

A Mining Journey to North-West Canada (Voyage Minier au Nord-Ouest Canadien). J. M. Bel. A very full account of travels in the Canadian Yukon district, with especial reference to mining developments. 12,000 w. 4 plates. Mem Soc Ing Civ de France—Nov., 1904. No. 67359 G.

Crushing.

Crushing with Rolls. R. K. Humphrey. Remarks on methods of crushing, with a discussion of the modern crushing rolls, and their troubles. 2200 w. Eng & Min Jour—Jan. 12, 1905. No. 67201.

Drainage.

German Electrical Installations: Mine Drainage and Ventilation. Emile Guarini. An illustrated article describing the uses to which electricity is applied in the mines. 2500 w. Min Mag—Jan., 1905. No. 67227 C.

Fuse.

Notes on Safety Fuse: Its Manufacture, Testing and Use. James Thomas. A discussion of points named. 5000 w. Jour Chem, Met & Min Soc of S Africa—Nov., 1904. No. 67428 E.

Haulage.

An Approved System of Mine Haulage. Benedict Shubart. An illustrated description of the Morgan third-rail system. 900 w. Min Rept—Jan. 12, 1905. No. 67182.

Ontario.

Ontario. Thomas W. Gibson. Reviews the mining industry for 1904 in this province, where nickel, copper, iron, silver, gold, arsenic, mica, corundum, salt, gypsum and petroleum are among the products. 2200 w. Eng & Min Jour—Jan. 5, 1905. No. 67091.

Power Plant.

The Power Plant of the De Beers Consolidated Mines, Ltd. Alpheus F. Williams. An illustrated description of steam turbines and electrical apparatus at the diamond fields of Kimberley, South Africa, and some of the uses for which the current is utilized. 3600 w. Eng Rec—Jan. 7, 1905. No. 67065.

Quarry.

A Modern Quarry Plant in Mexico. Illustrated description of the equipment of the Hueyapam quarries, and the methods of quarrying. 1200 w. Compressed Air—Jan., 1905. No. 67239.

Refining.

Electrolytic Refining of Lead and the Treatment of Slimes Resulting Therefrom at the Canadian Smelting Works at Trail, British Columbia. Robert L. Whitehead. Ill. 4500 w. Mines & Min—Jan., 1905. No. 67079 C.

Roasting Furnace.

The Holthoff Revolving Hearth Roast-

ing Furnace. Illustrated description. 1200 w. Min Rept—Jan. 12, 1905. No. 67183.

Rock Crushing.

Rock Crushing by Water Power. R. T. Mishler. Describes experiments made with the object of developing a method of calculating the horse power of a water motor, and determining the work required to crush different ores when the crusher is run at different speeds. 1700 w. Cal Jour of Tech—Nov., 1904. No. 67215 C.

Rotary Furnace.

The Rotary Furnace for Roasting Quicksilver Ores. John W. Geary. An illustrated article giving some of the leading features of the process of roasting quicksilver ores as carried out at the Socrates Quicksilver Mine, of California. 1200 w. Cal Jour of Tech—Nov., 1904. No. 67212 C.

Safety Devices.

Improved Saiety Devices Against Overwinding (Neue Sicherheitsvorrichtungen gegen das Uebertreiben). H. Jicinsky. Illustrating devices for automatically stopping the engine when the cage reaches the upper safe limit. 3000 w. 1 plate. Oesterr Zeitschr f Berg u Hüttenwesen—Dec. 10, 1904. No. 67377 D.

Sampler.

Improved Sands and Slimes Samplers. Illustrated description of two recently devised appliances. 800 w. Jour Chem, Met & Min Soc of S Africa—Nov., 1904. No. 67429 E.

Shaft Sinking.

Corrugated Tubings for Lining Colliery Shafts. Prof. Heise, in *Gluckauf*. Illustrates form of corrugated tubings, claiming to overcome the defects of previously used linings. 900 w. Ir & Coal Trds Rev—Dec. 30, 1904. No. 67147 A.

Recent Application of the Freezing Process to the Augusta Victoria Mine, Westphalia (Die Neueste Anwendung des Gefrierverfahrens auf der Zeche Auguste Victoria i. W.). H. Joosten. A successful application of the Poetsch freezing process for deepening a shaft through 20 metres of quicksand. Two articles. 2 plates. 8000 w. Gluckauf—Dec. 10, 17, 1904. No. 67374 each B.

Sinking a Shaft by the Freezing Process. From an article by Herr Joosten, in *Gluckauf*. Illustrated description of the work. 3500 w. Ir & Coal Trds Rev—Jan. 13, 1905. No. 67460 A.

Timbering.

Methods of Renewing Old Timbering at the Dives-Pelican Mine, Silver Plume, Colorado. James F. McClelland. Illustrates and describes details of dangerous work, stating the conditions. 2800 w. Sch of Miner Qr—Nov., 1904. No. 67240 D.

Winding Engines.

Coupled Winding-Engine. Illustrated description of Corliss winding engines constructed for the gold mines at Kalgoorlie, Western Australia. 800 w. Engng—Dec. 23, 1904. No. 67016 A.

Electric Winding Engine at Tiremande Colliery. Illustrates and describes an engine recently erected in France designed to raise 105 tons of coal per hour from a depth of 1,412 ft. at a velocity of 26 ft. per second. 1600 w. Ir & Coal Trds Rev—Dec. 30, 1904. No. 67146 A.

The Electric Mine Hoist at the Tolling Shaft at Leoben (Die Elektrische Schachtfördermaschine System Ilgner in Tollinggraben bei Leoben). J. von Lidl. Describing the application of electric power to mine hoisting, handling loads of 800 kilogrammes to a depth of 80 metres at a speed of 2.4 metres per second. 3000 w. 1 plate. Oesterr Zeitschr f Beig u Hüttenwesen—Dec. 3, 1904. No. 67375 D.

MISCELLANY.

Diamonds.

Borts and Carbons, Their Occurrence, Uses, Etc. D. Dessau. An illustrated description of these two minerals, which are pure carbon and entitled to the name of diamonds. 2300 w. Min Wld—Dec. 31, 1904. No. 66977.

Grindstones.

The Production of Grindstones. An illustrated article describing the methods used in the Silverwood quarry, near Sheffield, Eng. 2000 w. Quarry—Jan., 1905. No. 67120 A.

Petroleum Refuse.

The Applications of Petroleum Refuse as Fuel (Masut-Jeuerungen und ihre Anwendung). Ferd. Heck. An account of the methods of burning petroleum residues as a fuel for open-hearth metallurgical furnaces. 2500 w. Stahl u Eisen—Dec. 15, 1904. No. 67347 D.

Pipe Line.

A 100-Mile Oil Pumping Line. A. M. Hunt. A description of a new six-inch line recently put in operation by the Coalinga Oil and Transportation Co., and the method used in trying to predetermine the resistance to pumping. Ills. 2500 w. Jour of Elec—Jan., 1905. No. 67101 C.

Salt.

Salt-Making in the Far West. E. Goldsmith. Describes the method used for procuring salt from the Pacific Ocean or

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from Great Salt Lake. 2000 w. Jour Fr Inst—Jan., 1905. No. 67246 D.

Tin Plate.

See Industrial Economy.

Wolfram.

Wolfram: How to Know It. B. Dunstan. Notes describing the physical characteristics, properties and other information useful to the prospector. 1500 w. N Z Mines Rec—Nov. 16, 1904. No. 67119 B.

Zinc.

Zinc. W. R. Ingalls. Information concerning the production of the Joplin and other districts. 1200 w. Eng & Min Jour—Jan. 5, 1905. No. 67084.

Notes on the Metallurgy of Sulphur Compounds in the Zinc Retort. Woolsey McA. Johnson. An account by experimental investigation of the action of sulphur in a zinc retort. 2200 w. Elec-Chem & Met Ind—Jan., 1905. No. 67106 C.

Review of the Zinc Industry. Franz Meyer. Information concerning the present state of this industry, considering the ores, roasting, smelting, zinc dust, etc. 3800 w. Elec-Chem & Met Ind—Jan., 1905. No. 67104 C.

The Decomposition and Formation of Zinc Sulphate by Heating and Roasting. H. O. Hoffman. Considers the decomposition by heating in air, and by heating with carbon; and its formation by roasting. Also the formation of zinc ferrate. 12,000 w. Tech Qr—Dec., 1904. No. 67421 E.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION.

Accidents.

American and British Reports on Railway Accidents. Slason Thompson. A criticism of the reports of the Interstate Commerce Commission, and a comparison with the British reports, and a discussion of other topics bearing upon safe transportation. General discussion. 14400 w. Pro W Ry Club—Dec. 20, 1904. No. 67264 C.

Cheap Service.

On the Question of the Organization of a Cheap Service on a Main Railway's Branch Lines Which Carry Little Traffic and on Light Railways (Subject XIX for Discussion at the Seventh Session of the Railway Congress). J. Rocca. Report No. 1, for all countries, except America, Austria-Hungary, Germany and Holland. 19,000 w. 3 tables and fig. Bul Int Ry Cong—Dec., 1904. No. 67487 E.

Instruction.

A System of Teaching Combustion to Engineers and Firemen. Mr. Buell. Outlines the system taught by the International Correspondence School of Scranton, Pa., explaining how the fuel burns, what the products of combustion are, and how to secure the proper conditions. General discussion. 8500 w. S & S W Ry Club—Nov., 1904. No. 67266 E.

Transportation.

Automobile vs. Railway Transportation. Paul Synnestoedt. Comparison between conditions to be met in railroad service and those which must be considered in automobile transportation. Ills. 6000 w. Pro of Ry Club of Pittsburg—Nov., 1904. No. 67511 C.

MOTIVE POWER AND EQUIPMENT.

Cars.

High-Capacity Cars on the Great Central of England. Illustrates and describes several types of steel cars recently put in service. 1000 w. R R Gaz—Vol. XXXVIII, No. 3. No. 67283.

Car Wheels.

See Mechanical Engineering, Machine Works and Foundries.

Counterbalancing.

Locomotive Counterbalancing. Roger Atkinson. Gives directions for counterbalancing. Ills. 1500 w. Ry & Loc Engng—Jan., 1905. No. 67042 C.

Coupling.

Central Buffer Claw Coupling (Mittelpuffer-Klauenkupplung). A description of the Scheib car coupler, a modified form of the American Master Car Builders' design. 1200 w. Glasers Annalen—Jan. 1, 1905. No. 67328 D.

Cylinder Clearance.

Cylinder Clearance and Valve Events. O. W. Young. Gives diagrams illustrating points the writer desires to make in regard to the importance of reducing back pressure, giving suggestions of value. General discussion. 11,000 w. Pro W. Ry Club—Dec. 20, 1904. No. 67265 C.

Electric Locomotives.

See Street and Electric Railways.

We supply copies of these articles. See page 1038.

Explosion.

Explosion of a Locomotive Engine (Explosion d'une Locomotive). S. Périssé. A full report upon the explosion of a locomotive at the Gare St. Lazare, Paris, July 4, 1904, with data of tests of the material of the exploded boiler. 4000 w. Génie Civil—Dec. 17, 1904. No. 67309 D.

Furnace.

The Langer Smokeless Furnace on the Swiss Locomotives (Le Fumivore Automatique Langer sur les Locomotives Swisses). Emile Bernheim. Describing a combination of steam jet and brick arch, which has been effectively used on the Viège-Zermatt line. 2000 w. Bul Soc d'Encour—Nov. 30, 1904. No. 67341 G.

Locomotive Design.

The Tendencies of British Locomotive Design. J. F. Gairns. Notes the principal features of recent locomotive design in Great Britain, tracing the development. 2000 w. Prac Engr—Dec. 23, 1904. No. 66996 A.

Locomotives.

A French Opinion on American Locomotives. Daniel Bellet. Some information concerning the experiments in France with the American locomotives, and the comparisons made with the French machines. 3000 w. Sci Am Sup—Jan. 14, 1905. No. 67161.

Express Passenger Locomotive for the Great Central Railway. Gives dimensions of six-coupled engines, with their tenders, with illustrations. 800 w. Engng—Dec. 30, 1904. No. 67137 A.

Freight and Passenger Locomotives. An illustrated description of heavy freight locomotives of the 2-8-2 Mikado type, for the Northern Pacific Railway. 800 w. Am Engr & RR Jour—Jan., 1905. No. 66991 C.

Mikado (2-8-2) Locomotive for the Northern Pacific. Illustrated description, with dimensions. 3300 w. R R Gaz—Vol. XXXVIII, No. 3. No. 65280.

On the Question of Locomotives of Great Power (Subject V for Discussion at the Seventh Session of the Railway Congress). E. Sauvage. Report No. 1 for all countries except America. 21,400 w. 14 tables. Bul Int Ry Cong—Dec., 1904. No. 67484 E.

Powerful Prairie Type Locomotives. Shows side elevation, sections, the leading truck, stack, and the arrangement of the front end, with brief description. 500 w. Am Engr & R R Jour—Jan., 1905. No. 66994 C.

The Balanced Compound-Results Obtained from Service. Lanford H. Fry. An illustrated description of this type of locomotive, with illustrations of various machines and report of their working. General discussion. 6000 w. Pro W Ry Club—Dec. 20, 1904. No. 67263 C.

The New Compound Locomotives for the Rhaeticon Railway (Die Neue 4-5 Gekuppelte Verbunde-Lokomotive der Rhätischen Bahn). An illustrated description of a 46-ton two-cylinder compound engine built at the Winterthur works. 1000 w. Schwerz Bauzeitung—Jan. 7, 1905. No. 67339 B.

Petrol.

A Petrol Motor Car for Railways. Illustrates and describes the Dick-Kerr petrol motor car being tried on the Great Northern Railway of England. 900 w. Tram & Ry Wld—Jan. 12, 1905. No. 67446 B.

Petrol Locomotive for Light Railways. Illustrated description of a locomotive built for a 2 ft. 9½ in. gauge. 1200 w. Engng—Jan. 13, 1905. No. 67449 A.

Resistance.

Tractive Resistance of Loaded Railway-Wagons. J. A. F. Aspinall. Paper presented Inst. of Civ. Engrs. (England). An account of experiments made to determine the resistances of 10-ton, 20-ton and 30-ton railway wagons, loaded to their full capacity. Ills. 1100 w. R R Gaz—Vol. XXXVIII, No. 1. No. 67052.

Train Lighting.

See Electrical Engineering, Lighting.

Train Pipes.

The Forsyth Automatic Train Pipe Coupler. J. P. Kelly. Illustrated description of the device and its operation. 500 w. Ry & Loc Engng—Jan., 1905. No. 67043 C.

PERMANENT WAY AND BUILDINGS.

Block System.

On the Question of the Automatic Block System (Subject X for Discussion at the Seventh Session of the Railway Congress). Mr. Margot. Report No. 2 for all countries except America. 10,800 w. 4 tables. Bul Int Ry Cong—Dec., 1904. No. 67483 E.

Theory and Practice of Single-Track Blocking. H. D. Emerson. A discussion of the advantages of the block system, with much related information of interest, and general discussion. 29,700 w. N Y R R Club—Dec. 16, 1904. No. 67268.

Construction.

The Building of the Chicago, Cincinnati & Louisville and Cincinnati, Richmond & Muncie Railroads. H. L. Weber and Fred R. Charles. Illustrates and describes rapid construction, with interesting engineering

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features. 2000 w. Eng Rec—Jan. 21, 1905. No. 67402.

Foundation-Beds.

Preparing Foundation-Beds for Short Railway Spans. Walter N. Frickstad. Describes the manner in which the foundation-beds for the concrete and masonry on which rest the steel superstructure of some of the bridges recently built by the Southern Pacific in Nevada were prepared, without the use of machinery, except pump and boiler. 4000 w. Cal Jour of Tech—Nov., 1904. No. 67214 C.

Location.

Methods of Location on the Choctaw, Oklahoma & Gulf Railroad. F. Lavis. On the methods of making surveys as practiced on this road, the organization and equipment of parties, etc. 9500 w. Pro Am Soc of Civ Engrs—Dec., 1904. No. 66968 E.

Rail Steel.

The Relative Value of Basic Martin Steel and Thomas Steel for Rails (Empfielt es sich Eisenbahnschienen aus Basischem Martinstahl statt aus Thomasstahl herzustellen). Dr. W. Wedding. A discussion of the value of basic steel rails, advocating the Talbot process. 3500 w. Glasers Annalen—Jan. 1, 1905. No. 67326 D.

Shops.

East Buffalo Locomotive Repair Shop of the Delaware, Lackawanna & Western. Illustrates and describes the rebuilt and enlarged shops at this point, and their equipment. 1200 w. Ry Age—Dec. 30, 1904. No. 66966.

Organization and Operation of a Railroad Blacksmith Shop. A. W. McCaslin. Hints for the foreman and explanation of methods found satisfactory. 1800 w. Am Eng & R R Jour—Jan., 1905. No. 66992 C.

The Steelwork of the Lehigh Valley R. R. Shops at Sayre. An illustrated article dealing with the design and details of the steelwork of these locomotive repair shops. 3400 w. Eng Rec—Jan. 21, 1905. No. 67406.

Signals.

Carbonic Acid Gas for Signals. P. G. Ten Eyck. Explains its use under compression as a power for operating semaphore signals. 1500 w. R R Gaz—Vol. XXXVIII, No. 3. No. 67281.

Interlocking Plants of the Metropolitan Elevated Railway, Chicago. Illustrated description. 800 w. Ry Age—Jan. 13, 1905. No. 67163.

Storage Batteries for Block Signals. E. L. Reynolds. Abstract of a paper read before the Ry. Signal Assn. Reports of companies that have been using storage batteries for signal work, and remarks on the importance of the operating men understanding the best method of operating the cells. 1500 w. R R Gaz—Vol. XXXVIII, No. 2. No. 67164.

Sink-Holes.

Haslett Park Sink-Hole, Grand Trunk Ry. Leslie A. Waterbury, in the *Michigan Engineer*. Describes one of many sink-holes in Michigan which have caused track troubles. Ills. 1500 w. Ry & Engng Rev—Dec. 31, 1904. No. 67025.

Terminals.

Chicago Railway Terminals. Frederic A. Delano. An illustrated article outlining a plan to bring the six different passenger terminals to one point in the city. 2800 w. R R Gaz—Vol. XXXVIII, No. 2. No. 67165.

Proposed Union Station for Buffalo. Extract from a report by W. J. Wilgus. Plan and information of a proposed terminal in which thirteen roads are interested. 1000 w. R R Gaz—Vol. XXXVIII, No. 1. No. 67051.

The Power Plant of a Modern Railroad Terminal. J. R. Bibbins. Illustrated description of an exemplary plant placed in operation at St. Louis embracing a service for electric lighting, electric power, compressed air, steam and water. 5400 w. Eng Rec—Jan. 28, 1905. No. 67519.

The New Grand Central Station. Brief illustrated description of the proposed structure, with editorial. 2400 w. Sci Am —Jan. 21, 1905. No. 67289.

Yards.

Teaming Yards at Railway Stations. H. J. Pfeifer. Read before the St. Louis Ry. Club. Discusses the qualities of a properly constructed yard and its care. 1600 w. Eng News—Jan. 19, 1905. No. 67286.

TRAFFIC.

Rates.

The Regulating of Railroad Rates. Hon. Martin A. Knapp. Outlines the questions involved and the principles to be applied in the regulation of railroad rates by public authority. 3000 w. R R Gaz—Vol. XXXVIII, No. 2. No. 67166.

Review.

Review of Traffic Questions. C. Colson. The railways in 1902 and 1903 in France, England and Germany. 5000 w. 5 tables. Bul Int Ry Cong—Dec., 1904. No. 67488 E.

Suburban Traffic.

On the Question of the Suburban Traffic (Subject XII for Discussion at Seventh Session of the Railway Congress).

We supply copies of these articles. See page 1038.

H. G. Drury. Report No. 2 for all countries except America. 19,800 w. 9 tables & figure. Bul Int Ry Cong—Dec., 1904. No. 67482 E.

MISCELLANY.

Light Railways.

On the Question of the Direct Financial Co-operation by the State and by Localities Interested in the Development of Light Railways (Subject XVIII for Discussion at the Seventh Session of the Railway Congress). E. A. Ziffer. Report No. 2 for all countries, except Belgium, France, England and Germany. 12,600 w. 1 table. Bul Int Ry Cong—Dec., 1904. No. 67486 E.

Provident Institutions.

On the Question of Provident Institutions (Subject XVI for Discussion at the Seventh Session of the Railway Congress). M. Riebenack. Report No. 1 for countries using the English language. 3500 w. 14 tables. Bul Int Ry Cong—Dec., 1904. No. 67485 E.

Sumatra.

Railways in Southern Sumatra (Spoorwegen in Zuid-Sumatra). J. L. Cluysenaer. With map showing the connections, and some account of the traffic; the entire system includes 1,355 kilometres of track. 7500 w. De Ingenieur—Dec. 17, 1904. No. 67351 D.

STREET AND ELECTRIC RAILWAYS

Acceleration.

The Numerical Computation of the Acceleration Curves for Electric Railways (Rechnerische Bestimmung der Anfahrlinien Elektrischer Vollbahnen). Dr. W. Kummer. A derivation of the mathematical formulas, and their application to concrete examples. 2500 w. Schweiz Bauzeitung—Dec. 17, 1904. No. 67337 B.

Alternating Current.

A Comparison of Alternating Current Railway Systems. J. H. Hallberg. States some of the requirements of electric locomotives for heavy traction, and the four different systems and types of locomotives that have been considered; and describes the Hallberg single-phase to polyphase system, and the Hallberg locomotive. 3800 w. Elec Wld & Engr—Jan. 14, 1905. No. 67187.

Batteries.

On Batteries with Reversible Boosters. C. Turnbull. Read before the Newcastle Sec. of the Inst. of Elec. Engrs. Deals with some of the aspects of this solution of a very fluctuating traction load. 4500 w. Elec Engr, Lond—Dec. 23, 1904. No. 67009 A.

Canal Conversion.

The Conversion of English Canals into Electric Railways. F. F. Bennett. Outlines a scheme of amalgamation and electrification, aiming to prove that the change would give profits. 6000 w. Public Works —Jan., 1905. No. 67465 F.

Conflicts.

Street Railway and Highway Conflicts. A review of an interesting paper by Bentley W. Warren, at a Boston meeting of the Good Roads Assn. 6000 w. St Ry Rev—Jan. 15, 1905. No. 67417 C.

Controller.

The Surface Car Controller—Its Performance, Inspection and Efficiency. Edward Taylor. Treats of the type known as the K controllers, discussing explosions, the remedy, effect of operating conditions, &c. 3500 w. St Ry Jour—Jan. 7, 1905. No. 67064 C.

Electric Railways.

The Electric Railway Situation. Dr. Louis Bell. A review of the progress during the past year. 1500 w. Elec Rev, N. Y.—Jan. 14, 1905. No. 67169.

Electrification.

The Application of Electricity to Steam Roads. L. S. Cass. Gives results from practice on 80 miles of track over which are operated electric street cars, electric interurban cars, electric switch engines, and standard and Mogul steam locomotives. Discussion. 3800 w. Pro Iowa Ry Club—Dec. 12, 1904. No. 67267 C.

Gas Power.

The Reconstruction of the Mödling—Hinterbrühl Electric Railway (Die Rekonstruktion der Elektrischen Bahn Mödling—Hinterbrühl). Describing the modernization of the oldest electric railway in Austria, in connection with the introduction of gas engines as prime movers at the power station. Two articles. 6000 w. Zeitschr d Oesterr Ing u Arch Ver—Dec. 16, 23, 1904. No. 67330 each D.

Heavy Traction.

Discussion on "Problems of Heavy

We supply copies of these articles. See page 1038.

Electric Traction." Discussions at New York, and at Pittsburg, of the paper by Messrs. Lyford and Smith. 13000 w. Pro Am Inst of Elec Engrs—Jan., 1905. No. 67262 D.

Holland.

The Amsterdam-Haarlem Electric Railway. A full illustrated description of this recently completed line. 7000 w. Elec Engr, Lond—Jan. 6, 1905. No. 67194 A.

The Amsterdam-Haarlem Tramways System. An illustrated detailed description of the construction of this road, and an account of the conditions of franchise, contracts, &c. 5000 w. St Ry Jour—Jan. 7, 1905. No. 67061 C.

The Power Station of the Amsterdam-Haarlem Electric Ry. An illustrated detailed description of the power house at Halfweg. 2200 w. Eng Rec—Jan. 7, 1905. No. 67069.

Hong Kong.

Electric Tramways in Hong Kong. Brief illustrated description of this pioneer system of electric traction in China, with information in regard to the city and surroundings. 2200 w. Elec Engr, Lond—Jan. 13, 1905. No. 67439 A.

Interurban.

Ft. Wayne, Van Wert & Lima Traction Co. Illustrates and describes a recently completed electric railway, as an example of good construction work rapidly executed. 2000 w. St Ry Rev—Jan. 15, 1905. No. 67418 C.

The System of the Stark Electric Railroad Company. An illustrated description of a line in Ohio, built on private right of way. 5000 w. St Ry Jour—Jan. 7, 1905. No. 67060 C.

Legislation.

Electric Tramway Legislation in the Colonies and India. A short summary of the law as now enforced. 4600 w. Elec Rev, Lond—Dec. 30, 1904. No. 67129 A.

Locomotives.

The New Jungfrau Locomotives. C. L. Durand. Illustrated description of the three-phase electric locomotives now used on this road, which are working successfully. 2000 w. Elec Rev, N. Y.—Dec. 31, 1904. No. 66981.

Why Steam Locomotives Must Be Replaced by Electric Locomotives for the Heaviest Freight Service. H. Ward Leonard. Presents facts and arguments tending to show that the electric locomotive will, because of its great economic superiority, replace steam locomotives for the heaviest freight traffic. 4500 w. Elec Wld & Engr—Jan. 7, 1905. No. 67095.

London.

London Electric Railways. Robert P. Porter. Reviews electrical street railway work in London, New York, Paris, Chicago, Berlin, and Boston, especially the underground railways, with conclusions and general discussion. 20000 w. Jour Soc of Arts—Jan. 27, 1905. No. 67670 A.

Mont Blanc.

The Mont Blanc Electric Railway (Die Elektrische Bahn auf dem Mont Blanc). An illustrated account of the proposed electric railway to the summit of Mont Blanc, with profiles and views of the route, and sections of the tunnels. Two articles. 3500 w. Ill Zeitschr f Klein u Strassenbahnen—Nov. 16, Dec. 7, 1904. No. 67389 each D.

Overhead Equipment.

Tramway Overhead Equipment Materials. H. M. Sayers. Read from the Tram. & Light Rys. Assn. Gives a brief analysis of the mechanical and electrical conditions to be satisfied, with reference to the design and erection of the line, materials, &c. 7500 w. Elec Engr, Lond—Jan. 20, 1905. No. 67532 A.

Power House.

A London Electric Railway Power House. Illustrated description of the generating station in Lot's Road, Chelsea. 2800 w. Elec Wld & Engr—Jan. 14, 1905. No. 67185.

Long Island City Power House of the Pennsylvania Railroad. Illustrated description of an installation designed to supply power for the operation of trains through the East River tunnel and for lines now being equipped with electricity by the Long Island Railroad Co. 1800 w. St Ry Jour—Jan. 7, 1905. No. 67062 C.

Steam-Turbine Power Plant of the New York, New Haven & Hartford Railroad at Warren, R. I. Illustrates and describes a plant noteworthy from the directness of the steam lines and the absence of a multiplicity of pipes. 1500 w. St Ry Jour—Jan. 21, 1905. No. 67295 C.

Power Production.

Cost of Electric Railway Power Production and Transmission in the State of Indiana. A. S. Richey. Read before the Indiana Elec. Ry. Assn. Valuable statistics and analysis of costs. 2400 w. St Ry Jour—Jan. 21, 1905. No. 67296 C.

Rail Resistance.

Resistance and Current Flow (Widerstand und Stromverlauf). Dr. Richard Heilbrun. Experimental determinations

We supply copies of these articles. See page 1038.

of the resistance offered by rails and rail bonds to the passage of the return current in tramways. 3000 w. Elektrotech Zeitschr—Dec. 22, 1904. No. 67361 B.

Rail-Welding.

Thermit Rail-Welding at Hartford, Conn. An illustrated account of results secured with the Goldschmidt thermit rail-welding process. 2200 w. St Ry Jour—Jan. 28, 1905. No. 67555 C.

Recorder.

Car-Test Recorder of the Boston Elevated Railway Company. J. M. Ayer and H. S. Knowlton. Illustrates and describes the apparatus for securing automatic test records and its operation. 11000 w. St Ry Jour—Jan. 14, 1905. No. 67167 C.

Roadbed.

Track and Roadbed Construction and Maintenance with Particular Reference to the Life and Chemical Preservation of Ties. Thomas B. McMath. Read before the Indiana Elec. Ry. Assn. Gives information concerning ties treated with creosote and methods of track laying and paving. 1700 w. St Ry Jour—Jan. 21, 1905. No. 67297 C.

San Francisco.

Miscellaneous Equipment of the United Railroads of San Francisco. An illustrated article briefly describing parlor cars, observation cars, funeral cars, electric mail car, cable mail cars, street sweeping cars, oil tank car, trolley tower cars, freight cars, oil-sprinkling car, wrecking cars, sand car, and instruction car. 2500 w. St Ry Rev—Jan. 15, 1905. No. 67416 C.

Shops.

Repair Shop Practice on the Jackson & Battle Creek Third-Rail System. An illustrated description of the repair shop facilities and methods. 4800 w. St Ry Jour—Jan. 7, 1905. No. 67063 C.

Single Phase.

London, Brighton and South Coast Railway and Electric Traction. Gives an account of the circumstances which led to the decision to use overhead conductors fed with single-phase alternating-current at high pressure, with some particulars of the equipment. 3300 w. Elec Rev, Lond—Jan. 20, 1905. No. 67536 A.

Sleet.

Fighting Sleet on the Aurora, Elgin & Chicago Railway. An illustrated article explaining the method of using a solution of calcium chloride. 1100 w. St Ry Jour—Jan. 21, 1905. No. 67294 C.

Sprinkler.

Electric Sprinkler for the City of Cologne (Arroseuse de la Ville de Cologne). B. Géron. Illustrating an electric tram car carrying a water tank and sprinklers for watering the streets. 2000 w. Génie Civil—Jan. 7, 1905. No. 67314 D.

Stray Currents.

See Civil Engineering, Water Supply.

Subway.

The Extension of the New York Rapid Transit Lines. Map, with account of plans outlined in a recent report by William Barclay Parsons for additional lines in Manhattan, Brooklyn, and the Bronx. 2500 w. Eng Rec—Jan. 7, 1905. No. 67071.

The New York Subway (Le Métropolitain "Subway" de New York). Ch. Dantin. A well illustrated account of the underground railway in New York City. Two articles. 6000 w. 2 plates. Génie Civil—Dec. 24, 31, 1904. No. 67310 each D.

Suspension Railway.

New Bogies for the Elberfeld Suspension Railway. An illustrated explanation of an improvement made by introducing a new design of suspending bogie, and the objects fulfilled by the alteration. 1200 w. Engr, Lond—Jan. 13, 1905. No. 67456 A.

Terminal Station.

The New Terminal Station of the Indianapolis Traction Terminal Co. Illustrated description of a fine building in Indianapolis, which compares favorably with the buildings provided by steam railroads. 3000 w. St Ry Rev—Jan. 15, 1905. No. 67419 C.

Tires.

The Steel-Tired Wheel in Street Railway Service. Norman McD. Crawford. Gives facts from the experience of the Hartford Street Railway Company, showing that these wheels are superior not only in safety and serviceability, but also in economy. 2200 w. St Ry Jour—Jan. 21, 1905. No. 67293 C.

Vienna.

Conduits and Conductors of the Electric Tramways of Vienna (Caniveaux el Prises de Courant des Tramways Electriques de Vienne). With sections of the underground conduits, arrangement of feeders, crossings, switches, etc. 1500 w. Génie Civil—Jan. 7, 1905. No. 67317 D.

We supply copies of these articles. See page 1038.

EXPLANATORY NOTE—THE ENGINEERING INDEX.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first installment.

SPECIAL NOTICE.—To avoid the inconvenience of letter-writing and small remittances, especially from foreign countries, and to cheapen the cost of articles to those who order frequently, we sell coupons at the following prices:—20 cts. each or twelve for $2.00, thirty-three for $5, and one hundred for $15.

Each coupon will be received by us in payment for any 20-cent article catalogued in the Index. For articles of a higher price, one of these coupons will be received for each 20 cents; thus, a 40-cent article will require two coupons; a 60-cent article, three coupons; and so on. The use of these coupons is strongly commended to our readers. They not only reduce the cost of articles 25 per cent. (from 20c. to 15c.), but they need only a trial to demonstrate their very great convenience—especially to engineers in foreign countries, or away from libraries and technical club facilities.

Write for a sample coupon—free to any part of the world.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of THE ENGINEERING MAGAZINE at 10 cts. per month, or $1.00 a year; to non-subscribers, 25 cts. per month, or $3.00 a year.

THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* Boston.
American Electrician. *m.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U.S.A.
American Machinist. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. d Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *qr.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Sydney.
Autocar. *w.* Coventry, England.
Automobile. *m.* New York.
Automobile Magazine. *m.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bulletin American Iron and Steel Asso. *w.* Philadelphia, U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. Soc. Int. d Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bulletin Univ. of Kansas. *b-m.* Lawrence.
Bull. Int. Railway Congress. *m.* Brussels.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Toronto and Montreal.
Canadian Mining Review. *m.* Montreal.
Cassier's Magazine. *m.* New York.
Cement. *b.-m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.

Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Electrical Engineer. *w.* London.
Electrical Review. *m.* London.
Electrical Review. *w.* New York.
Electrical World and Engineer. *w.* New York.
Electric Club Journal. *m.* Pittsburg, Pa.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electricity. *w.* London.
Electrochemical Industry. *m.* New York.
Electrochemist and Metallurgist. *w.* London.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Chicago.
Engineering. *w.* London.
Engineering and Mining Journal. *w.* New York.
Engineering Magazine. *m.* New York & London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Engineering Review. *m.* London.
Eng. Soc. of Western Penna. *m.* Pittsburg, U.S.A.
Engineering Times. *m.* London.
Fire and Water. *w.* New York.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e. d. Str. Ferr. *w.* Rome.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Ice and Refrigeration. *m.* New York.
Ill. Zeitschr. f. Klein u. Strassenbahnen. *s-m.* Berlin.
Ingenieria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron and Steel Metallurgist. *m.* Boston.
Iron and Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. Am. Foundrymen's Assoc. *m.* New York.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery *b-m.* Fort Monroe, U.S.A.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, U.S.A.
Locomotive. *m.* Hartford, U. S. A.
Locomotive Engineering. *m.* New York.
Machinery. *m.* New York.
Madrid Cientifico. *t-m.* Madrid.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Métallurgie. *w.* Paris.
Minero Mexicano. *w.* City of Mexico.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Magazine. *m.* New York.
Mining Reporter. *w.* Denver, U. S. A.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. *m.* Vienna.
Mouvement Maritime. *w.* Brussels.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *m.* New York.
Nature. *w.* London.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Nineteenth Century. *m.* London.
Oest. Wochenschr. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Page's Weekly. *w.* London.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Public Works. *m.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago
Review of Reviews. *m.* London & New York.
Revista d Obras. Pub. *w.* Madrid.
Revista Tech. Ind. *m.* Barcelona.
Revue de Mécanique. *m.* Paris.
Revue Gen. des Chemins de Fer. *m.* Paris.
Revue Gen. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Revue Technique. *b-m.* Paris.
Revue Universelle des Mines. *m.* Liége.
Rivista Gen. d Ferrovie. *w.* Florence.
Rivista Marittima. *m.* Rome.
Schiffbau. *s-m.* Berlin.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Engng. *m.* Ithaca, N. Y.
Stahl und Eisen. *s-m.* Düsseldorf.
Stevens' Institute Indicator. *qr.* Hoboken, U.S.A.
Street Railway Journal. *m.* New York.
Street Railway Review. *m.* Chicago.
Tijds. v h Kljk. Inst. v Ing. *qr.* Hague.
Traction and Transmission. *m.* London.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
World's Work. *m.* New York.
Yacht. *w.* Paris.
Zeitschr. d. Mitteleurop. Motorwagen Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a S.
Zeitschr. f. Elektrotechnik. *w.* Vienna.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

Electricity.

Experiments with Alternate Currents of High Potential and High Frequency. By Nikola Tesla. Size, 7 in. by 5 in.; pp. ix, 162. Price, $1.00. New York: McGraw Publishing Co.

A reprint, in neat book form, of a lecture originally delivered by Mr. Tesla before the Institution of Electrical Engineers in London, describing the remarkable results attained by the use of his apparatus for demonstrating the effects of high-pressure alternating currents.

The apparatus by means of which the high frequencies are obtained is described in detail, and the remarkable luminous, chemical, and electrical effects are discussed in a manner readily intelligible to an audience. The book is prefaced by a biographical sketch of Mr. Tesla, and has a supplement, giving an account of his experimental laboratory at Colorado Springs, and his tower and laboratory at Warderclyffe, Long Island.

Reinforced Concrete.

Reinforced Concrete. By Charles F. Marsh. Size, 11 in. by 8 in.; pp. 545. Price, 31s. 6d. ($7.00). London: Archibald Constable & Co. New York: D. Van Nostrand Company.

An exhaustive treatise upon a subject which is at present attracting much attention, both on the Continent and in America, Mr. Marsh's book may be welcomed as giving in one volume a résumé of the most important structures and methods in reinforced concrete.

After a general review of the whole subject the various systems which have been employed since the original work of Monier, this portion being very fully illustrated. A section on materials gives some useful information on the preparation of concrete, while the department on practical construction includes numerous examples chiefly taken from actual structures on the Continent.

The very full section on calculations is preceded by a chapter on experimental research and the data deduced therefrom, this giving the basis upon which computations are necessarily founded. The book concludes with a number of illustrations of engineering structures which have been erected in reinforced concrete, followed by a very complete index.

This is by far the best treatise upon the subject which we have yet seen, and it is certain to be consulted by those who are active in developing this important department in structural engineering, a department, the limitations of which can by no means be seen at the present time. With the increasing scarcity of timber it seems certain that reinforced-concrete piling will replace wooden piles, and it may be that this form of construction will enable the problem of the substitute for wooden railway sleepers to be solved.

While there is no doubt that much of the mathematical and theoretical discussion which is at present being given to the subject of reinforced concrete is of little more than academic interest, it is only by such discussions that the fundamental principles can be definitely settled, and this desirable end will certainly be aided by the collection of the various methods as in Mr. Marsh's book. The volume is especially well printed and fully illustrated.

BOOKS RECEIVED.

Reinforced Concrete. By A. W. Buel and C. S. Hill. New York: The Engineering News Publishing Co.

Steam Turbines, with an Appendix on Gas Turbines and the Future of Heat Engines. By A. Stodola. Translated from the German by Louis C. Loewenstein. New York: D. Van Nostrand Co., London: Archibald Constable and Company.

The Testing of Continuous-Current Machines. By Charles Kinzbrunner. New York: John Wiley & Sons.

Laboratory and Factory Tests in Electrical Engineering. By George F. Sever and Fitzhugh Townsend. New York: D. Van Nostrand Co.

The Mineral Industry. Vol. XII. Edited by D. H. Newland. New York and London: The Engineering and Mining Journal.

Mineral Resources of the United States. Report of the United States Geological Survey. Edited by Dr. David T. Day. Washington: Government Printing Office.

NEWS SUPPLEMENT

Coming Society Meetings.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION. Sec.: J. D. Farasey, Cleveland. Next meeting, Oct. 4-6, at St. Louis.

AMERICAN GAS LIGHT ASSOCIATION. Sec.: A. E. Forstall, 58 William St., New York. Annual convention, Oct. 19-21, at Washington.

AMERICAN INSTITUTE OF ARCHITECTS. Sec.: Glenn Brown, Washington, D. C. Annual convention, Dec. 15-17, at Wash-

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Sec.: Ralph W. Pope, 95 Liberty St., New York. Meetings on fourth Fridays.

AMERICAN INSTITUTE, POLYTECHNIC SECTION. Sec.: George Whitefield, Jr., 19 W. 44th St., New York. Meetings on first and third Tuesdays of each month, from October to May, inclusive.

AMERICAN RAILWAY ASSOCIATION. Sec.: W. F. Allen, 24 Park Place, New York. Next meeting, Oct. 26, at Philadelphia.

AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION. Sec.: Walter Mower, Detroit. Annual meeting, Oct. 10-15, at St. Louis.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Sec.: C. W. Hunt, 220 W. 57th St., New York. Regular meetings, first and third Wednesdays of each month, except July and August.
ington.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Sec.: Prof. F. R. Hutton, 12 W. 31st St., New York. Annual meeting, Dec. 6, at New York.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Sec.: Geo. W. Tillson, Municipal Building, Brooklyn, N. Y. Annual meeting, Oct. 4-6, at St. Louis.

AMERICAN STREET RAILWAY ASSOCIATION. Sec.: T. C. Penington, 2020 State St., Chicago. Annual meeting, Oct. 10-15, at St. Louis.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS. Sec.: S. F. Patterson, Concord, N. H. Annual convention, Oct. 18-20, at Chicago.

BOSTON SOCIETY OF CIVIL ENGINEERS. Sec.: S. E. Tinkham, 715 Tremont Temple. Regular meetings on third Wednesday of each month, except July and August.

BROOKLYN ENGINEERS' CLUB. Sec.: J. Strachan, 191 Montague St. Regular meetings on second Thursday of each month.

CANADIAN RAILWAY CLUB. Sec.: W. H. Rosevear, Jr., Montreal. Regular meetings on first Tuesday of each month, except June, July and August.

CANADIAN SOCIETY OF CIVIL ENGINEERS. Sec.: Prof. C. H. McLeod, 877 Dorchester St., Montreal. The General Section and the Electrical, Mechanical and Mining Sections meet on different Thursdays, from October to May.

CENTRAL RAILWAY CLUB. Sec.: Harry D. Vought, 62 Liberty St., New York. Regular meetings on second Friday of January, March, May, September and November, Hotel Iroquois, Buffalo.

CHICAGO ELECTRICAL ASSOCIATION. Sec.: W. B. Hale, Monadnock Building. Regular meetings on first and third Fridays of each month, from October to May.

CIVIL ENGINEERS' CLUB OF CLEVELAND. Sec.: Joseph C. Beardsley, 689 The Arcade. Regular meetings on second and fourth Tuesdays of each month.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL. Sec.: G. S. Edmondstone. Regular meetings on second Monday of each month.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Sec.: E. W. Poole, Bridgeport. Annual meeting in November.

ENGINEERING ASSOCIATION OF THE SOUTH. Sec.: Robt. L. Lund, 2102 Hayes St., Nashville, Tenn. Regular meetings on second Thursday of each month at the Berry Block. Convention at St. Louis.

ENGINEERS' CLUB OF CHICAGO. Sec.: B. W. Thurtell 1223 New York Life Building. Regular meetings on first and third Tuesdays of each month.

ENGINEERS' CLUB OF CINCINNATI. Sec.: J. F. Wilson, P. O. Box 333. Regular meeting on third Thursday of each month, except July and August.

ENGINEERS' CLUB OF COLUMBUS (OHIO). Sec.: H. M. Gates, 5½ West Broad St. Regular meetings on third Saturday of April, May, June and September, and on first and third Saturdays from October to March, inclusive.

ENGINEERS' CLUB OF MINNEAPOLIS. Sec.: Jas. B. Gilman, American Bridge Co. Regular meetings on third Monday of each month, except July and August.

ENGINEERS' CLUB OF PHILADELPHIA. Sec.: J. O. Clarke, 1122 Girard St. Regular meetings on first and third Saturdays of each month, except July and August.

ENGINEERS' CLUB OF ST. LOUIS. Sec.: H. J. Pfeifer, 920 Rialto Bldg. Regular meetings on first and third Wednesdays of each month.

ENGINEERS' SOCIETY OF WESTERN NEW YORK. Sec.: H. B. Alverson, 533 Ellicott Square, Buffalo. Regular meetings on first Tuesday of each month, except July and August.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. Sec.: Chas. W. Ridinger, 410 Penn Ave., Pittsburg. Regular meetings on third Tuesday of each month.

FRANKLIN INSTITUTE. Sec.: Dr. Wm. H. Wahl, 15 South 7th St., Philadelphia. General meetings on third Wednesday of each month, except July and August. General section meetings every Thursday.

HONOLULU ENGINEERING ASSOCIATION, Sec.: G. F. Bush, Honolulu, Hawaii.

INDIANA PUBLIC UTILITIES ASSOCIATION. Sec.: A. M. Barron, South Bend, Ind. Next meeting, Oct. 18, at Indianapolis.

INTERNATIONAL RAILWAY CONGRESS. General Sec.: Louis Weissenbruch, Belgian State Railways, Brussels, Belgium. Sec. of American Section: W. F. Allen, 24 Park Place, New York. Seventh session, May 3-15, 1905, at Washington.

IOWA RAILWAY CLUB. Sec.: P. B. Vermillion, Des Moines, Iowa. Regular meetings on third Tuesday of each month.

IRON AND STEEL INSTITUTE. Sec.: B. H. Brough, 28 Victoria St., London, S. W. Annual meeting, Oct. 24-26, at New York.

LOUISIANA ENGINEERING SOCIETY. Sec.: G. W. Lawes, 806 Gravier St., New Orleans. Regular meetings on second Monday of each month.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Sec.: Charles S. Clark, 70 Kilby St., Boston. Meetings second Wednesday of each month, except July and August.

MONTANA SOCIETY OF ENGINEERS. Sec.: Clinton H. Moore, Butte, Mont. Regular meetings on second Saturday in each month.

NEW ENGLAND RAILROAD CLUB. Sec.: Edw. L. Janes, Back Bay P. O., Boston. Regular meetings, second Tuesday in each month, except June, July, August and September, at Pierce Hall, Copley Square.

NEW ENGLAND STREET RAILWAY CLUB. Sec.: J. H. Neal, 101 Milk St., Boston. Meetings on last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Sec.: Geo. H. Guy, 114 Liberty St., New York. Meetings monthly, on different Wednesdays, at the American Institute, 19 W. 44th St.

NEW YORK RAILROAD CLUB. Sec.: Harry D. Vought, 62 Liberty St., New York. Regular meetings on third Friday of each month, except June, July and August, at Carnegie Hall, 154 W. 57th St., New York.

NEW YORK STREET RAILWAY ASSOCIATION. Sec.: W. W. Cole, Elmira. Annual meeting, Oct. 11 and 12, at Utica.

NORTHWESTERN ELECTRICAL ASSOCIATION. Sec.: Thos. R. Mercein, Milwaukee. Annual convention, Sept., at St. Louis.

NORTH-WEST RAILWAY CLUB. Sec.: T. W. Flannagan, Minneapolis, Minn. Regular meetings on first Tuesday after second Monday of each month, except June, July and August, alternating between Minneapolis and St. Paul.

OHIO SOCIETY OF MECHANICAL ELECTRICAL AND STEAM ENGINEERS. Sec.: Corwin J. Miller, Canton. Next meeting, Nov. 18, at Canton.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Sec.: Geo. P. Low, 237 Cherry St., San Francisco. Annual convention, third Tuesday in June. Intermediate meetings subject to call.

PACIFIC COAST RAILWAY CLUB. Sec.: C. C. Borton, West Oakland, Cal. Regular meetings on third Saturday of each month at San Francisco and other cities.

PACIFIC NORTHWEST SOCIETY OF ENGINEERS. Sec.: Prof. M. Roberts, Seattle, Wash. Meetings monthly in Chamber of Commerce rooms, Seattle.

RAILWAY CLUB OF PITTSBURG. Sec.: J. D. Conway, P. & L. E. R. R., Pittsburg, Pa. Regular meetings on fourth Friday of each month, at Hotel Henry.

RAILWAY SIGNAL ASSOCIATION. Sec.: B. B. Adams, 83 Fulton St., New York. Regular meetings on second Tuesdays of January, March, May, Sept. and Nov. Annual meeting, Oct. 11, at St. Louis.

RAILWAY WATER SUPPLY ASSOCIATION. Sec.: F. W. HAYDEN, Glencoe, Minn. Meetings on first Sunday of each quarter at Alexander Hall, South Minneapolis, Minn.

RICHMOND RAILWAY CLUB. Sec.: F. O. Robinson, 8th and Main Sts., Richmond, Va. Regular meetings on second Thursday of each month, except June, July and August.

ROCKY MOUNTAIN RAILWAY CLUB. Sec.: M. M. Currier, Colorado City. Regular meetings on second Tuesday of each month, at Union Depot, Denver.

ST. LOUIS RAILWAY CLUB. Sec.: E. A. Chenery, Union Station, St. Louis. Regular meetings on second Friday of each month, except July and August.

SOCIETY OF CHEMICAL INDUSTRY. NEW YORK SECTION. Sec.: H. Schweitzel, 40 Stone St. Meetings on third Friday after the first Monday of each month, except June, July, August and September, at Chemists' Club, 108 W. 55th St.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB. Sec.: W. A. Love, Atlanta, Ga. Regular meetings on third Thursday of Jan., April, Aug. and Nov., at Atlanta.

TECHNICAL SOCIETY OF THE PACIFIC COAST. Sec.: Otto von Geldern, 31 Post St., San Francisco. Regular meetings on first Friday of each month.

TECHNOLOGY CLUB OF SYRACUSE. Sec.: A. Frederic Witmer, 707 Dillaye Building. Meetings monthly, except in June, July, August and September.

TEXAS RAILWAY CLUB. Sec.: T. H. Osborne, Pine Bluff, Ark. Regular meetings on third Monday of April and September.

TOLEDO SOCIETY OF ENGINEERS. Sec.: L. M. Gram, 519 Gardner Building, Toledo, O. Meetings on third Friday of each month in National Union Building.

WESTERN RAILWAY CLUB. Sec.: J. W. Taylor, 667 Rookery, Chicago. Meetings on third Tuesday of each month, except June, July and August, Auditorium Hotel, Chicago.

WESTERN SOCIETY OF ENGINEERS. Sec.: J. H. Warder, Monadnock Block, Chicago. Regular meetings on first Wednesday and extra meetings on third Wednesday of each month, except July and August.

Personal.

—Mr. E. R. Carichoff, Member Am. Inst. of Elect. Engineers, announces that he has opened an office at No. 20 Broad street, New York City, for practice as a general consulting engineer. A specialty will be made of electric elevators and motor control, in the design of which he has had a long experience with the Sprague Electric Co., Otis Elevator Co. and General Electric Co. Also of examinations of inventions and patents.

—Mr. G. E. Bennett has been appointed by the Nernst Lamp Company to act as district sales manager of their Buffalo district office, recently established at 17 West Mohawk Street. These quarters will include an office, show room, exhibition room, and stock room, with a complete stock of lamps, and supplies to meet the requirements of the trade in this territory.

—Mr. Charles S. Miller, of Miller & Franklin, Production engineers, Boston, has recently returned from England, where he spent some time in two large manufacturing plants. He reports that American experience and American ideas are receiving very careful consideration at the hands of British manufacturers at the present time.

Industrial Notes.

—The Technology Club of Syracuse was organized at Syracuse, N. Y., early this year with a charter membership of 129, including engineers, architects, analytical chemists, metallurgists and geologists, the object of the organization being the promotion of professional and social intercourse among the members. The headquarters of the Club are located at No. 707 Dillaye Building, where rooms have been suitably furnished for library and social purposes. Meetings are held monthly, except during the months of June, July, August and September. The annual election of officers takes place at the October meeting. The following officers were elected at the organization meeting: Prof. John E. Sweet, president; Dean William Kent, 1st vice president; Henry C. Allen 2nd vice president; Edward N. Trump, John H. Barr, Edmund L. French, James A. Randall, directors; Alexander T. Brown, treasurer; A. Frederic Witmer, secretary. The club has taken a trip over the Auburn & Syracuse Electric Railway to Auburn, N. Y., where several large manufacturing plants, and the power house of the above mentioned Railway, were visited. These visits to manufacturing plants are to be made one of the special features of entertainment and instruction.

—Forty types of pumping machinery at the St. Louis Exposition are described and illustrated in a handsome pamphlet, 8½ by 12 inches in size, now being distributed by the International Steam Pump Co., of 114 Liberty Street, New York City. Under this heading are included not only the many types of pumps exhibited, but also air-compressing and steam-condensing apparatus, cooling towers, vacuum machines, water meters, etc., etc. The processes in which these machines are employed on the Exposition grounds, such as timber preserving and refrigeration, are fully explained, and diagrams and graphical charts are employed to illustrate the design and arrangement of apparatus. A striking view of the Grand Cascade is shown on the cover and the immense Worthington turbine pumps by which the water is supplied are described in the text. This publication is distributed gratis.

—The American Cement Co. and their agents, Lesley & Trinkle Co., have moved their offices to Rooms 604-610 Pennsylvania Building, 15th and Chestnut Streets, Philadelphia. This change has been made on account of the rapid growth of their business, which made larger offices and increased facilities necessary.

—The Chilian Government has placed a large order for equipment with the Ingersoll-Sergeant Drill Company, including a large Corliss compound compressor and a full complement of Haeseler pneumatic tools for one of its largest ship-yards.

—In connection with the Universal Exposition at Liége, Belgium, in 1905, there will be held, from June 26 to July 1, an international congress of mining, metallurgy, mechanical engineering and applied geology.

This congress is under the patronage of the Belgium government, and is being organized by the "Union des Charbonnages, Mines et Usines Metallurgiques de la Province de Liége" and the association of graduates of the Liége Technical High School. The president of the congress is M. Jules Magery, and the secretary general, M. Henri Dechamps.

—The Brown Corliss Engine Co., of Corliss, Wis., have been awarded a contract for four large vertical cross-compound Corliss engines, to be direct connected to electric generators, for the Washington navy yard.

—The Worcester Pressed Steel Company has been organized at Worcester, Mass., with Milton P. Higgins as president and John W. Higgins as general manager, and will build a large mill near there, equipped with modern machinery for the manufacture of pressed steel articles. The new corporation will also take over the management of the Worcester Ferrule and Manufacturing Company.

—The members of the Associazione Elettrotecnica Italiana, the representative society of electrical engineers in Italy, while passing through New York on their way to the Electrical Congress at St. Louis, paid a visit to the Crocker-Wheeler electrical works at Ampère, N. J., where they had luncheon and inspected the factory.

—Broderick & Bascom Rope Co. are issuing a booklet giving an illustration and a brief description of their striking exhibit at the St. Louis World's Fair, with appreciative comments by some of their visitors.

—The Harrison Safety Boiler Works, of Philadelphia, invite an inspection of their exhibits of Cochrane feed-water heaters, steam separators and oil separators and Sorge-Cochrane systems at the St. Louis Exposition.

—The American Sugar Refining Co., of New Orleans, La., has placed an order for a 16-inch Fittsburgh vacuum exhaust head with the Pittsburgh Gage & Supply Co., of Pittsburgh. This is the fourth repeat order.

—The Electric Controller and Supply Company, of Cleveland, Ohio, have an exhibit in the Palace of Electricity, at the St. Louis World's Fair, the striking feature of which is the direct motor drive for planers. This drive brings the planer to the same high efficiency as the motor-driven lathe. The motor is geared direct to the cross shaft, and instant change and control of speed is obtainable without changing gears or stopping planer. A new system of control especially adapted to mill table motors is shown in operation. This controller makes it impossible to injure the motor by "plugging," and will be of interest to all engineers and mill men. Several distinct lines of crane controllers are shown. These controllers are specially designed to withstand the rough handling usually the lot of such apparatus in mills and factories. They are all built with the resistance self-contained. All parts are easy of access for inspection, and wearing parts are made renewable, thus cutting the repair expense to a minimum. A line of knife switches, cast grid resistance banks, solenoids, magnetic friction and stop brakes and crane fittings are also shown and a working exhibit of the Clark lifting magnet. This magnet is suspended to a Brown Hoisting Machinery Co. tramway hoist and will be of special interest to those who have billets, slabs or plates to handle. The exhibit is in charge of an experienced electrical engineer, who will be pleased to give information to those interested.

—Warren Webster & Co. will install the Webster system of steam heating in the new department stores of John Wanamaker in Philadelphia and New York. This system has been in use for a number of years at the old Wanamaker store in Philadelphia, where it has given such satisfaction that it was adopted for the immense new stores.

—The World's Fair Street Railway Commission, which is making exhaustive electrical tests at the Bullock Electric Mfg. Company's exhibit at Section 15, Palace of Electricity, St. Louis Exposition, under the direction of Profs. Norris of Cornell, Swenson of Wisconsin and Plum of Perduex, got some interesting results last week while testing the temperature co-efficients of steel rails. These tests are made by taking the resistance of the rail at a normal temperature, then passing a large current through the rail to raise its temperature through a range of 30 degrees centigrade, and at various stages of heat making other tests. The results so far have been rather surprising. There seems to be but little difference in the resistances at the various temperatures.

It has been suggested that this may be due to the presence at the same time of iron and carbon in the steel, the one losing in conductivity while the other gains with the rise of temperature. So far the drop in voltage has been found to be much smaller with direct than with alternating current, and it varies much with the variations of current density and saturation. The relationship has not been established. Tests for this purpose will now be made with constant wave forms, those heretofore used having varied some in this respect.

—The Curtis & Co. Manufacturing Company have an interesting exhibit at the St. Louis World's Fair, in Machinery Hall, some of the features of which are as follows: A steam feed mill in actual operation, temporarily driven by compressed air supplied from motor driven air compressors, a small variable-friction feed mill and many other kinds of saw-mill machinery. Among the pneumatic machinery, besides the air compressors, are shown three Curtis pneumatic traveling cranes in operation, varying in capacity from 800 to 20,000 pounds, a freight elevator with direct hoist of 2500 pounds capacity, and a variety of other lifts and hoists. These machines have many distinctive and valuable features, and the whole exhibit is a very instructive one.

—The U. S. Wind Engine and Pump Co., of Batavia, Ill., have acquired all the patent rights of the Tweeddale Water Softening Co. and taken over their entire business, which will henceforth be conducted by the first-named company.

—The Aultman & Taylor Machinery Co., of Mansfield, Ohio, the manufacturers of the Cahall water-tube boilers, have an exhibit at the St. Louis World's Fair, which includes eight 508 horse-power horizontal boilers, built to carry 250 pounds steam pressure, four 508 horse-power horizontal boilers, for 175 pounds pressure, eight 400 horse-power horizontal boilers, also for 175 pounds pressure, and three 250 horse-power vertical boilers. All of these Cahall boilers have Aultman & Taylor chain-grate stokers, and each installation of horizontal boilers is equipped with an independent induced draft apparatus, and the coal is fed to the stoker hoppers by storage tanks and the conveyor system. Each vertical boiler has an independent stack and is operated with natural draft. The high-pressure boilers are used for operating the steam turbines that are located in the Palace of Machinery, and the other boilers supply steam for engines. All the boilers and stokers are located in the central portion of the Steam, Gas and Fuels Building, which is directly west of the Palace of Machinery. In addition to this working exhibit, the Aultman & Taylor Machinery Co. have a very large non-working exhibit situated in the northwest corner of the Palace of Machinery. This exhibit consists of one 125 horse-power horizontal water-tube boiler, equipped with the Aultman & Taylor Machinery Co.'s superheater and chain-grate stoker, and the boiler is bricked up on one side, leaving the other side exposed, so that the entire system can be examined. There is also one cross-drum type horizontal water-tube boiler of 100 horse-power capacity, bricked up entirely on one side, and one 100 horse-power vertical water-tube boiler, bricked up in similar manner. This exhibition is an extremely interesting one, as it permits of a thorough study of the different types, in which the travel of the gases can be easily followed. In addition to these three full-sized boilers, all of the parts are shown in unassembled condition.

—At the present time much interest centers in the steam turbine, which promises to reduce the weight and cost of prime movers. Two large machines of this type are on exhibition in block 51, aisle 1, and block 44, aisle 10, Machinery Building, at the St. Louis Fair, one being shown by the Westinghouse Machine Company and the other by the General Electric Company. Econimic utilization of the energy of steam requires its expansion to the lowest possible pressure, which in the turbine is accomplished without the usual losses due to the correspondingly low temperatures. In actual service the economy of the turbine is increased by approximately 3 to 5 per cent. for each inch of vacuum higher than 26 inches. It is therefore of vital importance that all losses should be reduced to a minimum. The absence of oil from the steam renders the use of a surface condenser desirable in places where the saving of condensed steam is important. The fact that the final temperature of the condensing water must be comparatively low necessi-

tates the highest degree of efficiency in its use and the immediate and complete removal of all non-condensible vapors, whose presence would increase the absolute pressure and consequently reduce the efficiency of the turbine. The steam from the Westinghouse-Parsons turbines at block 51 is condensed in a 1,500-square-foot surface condenser, supplied by Henry R. Worthington. The air is removed by a Worthington rotative dry vacuum pump of the center-crank type, but similar in other respects to the horizontal pumps already described. An air cooler is interposed between the condenser and the vacuum pump, considerably increasing the capacity and efficiency of the latter. The condensed steam is removed from the condenser, by a Worthington volute pump directly connected to an induction motor. The operation of this pump is very interesting, since it requires neither valves nor floats and is not subject to vapor binding, as are reciprocating pumps. The pump is placed below the level of the condencer, receiving the water by gravity and its capacity is such that it runs ahead of the supply, so that the suction pipe is never full. The discharge pipe is, however, always full and pressing back against the pump, but so long as the latter is in motion there is no possibility of the water passing back to the condenser, so no automatic devices are needed. In another turbine plant a pump of this character returns the hot water directly from the surface condenser to the boiler against a pressure of 250 pounds. The Curtis steam turbine, exhibited by the General Electric Company in block 44, is of the vertical type, and the condenser is placed in the base of the steam turbine. It contains 8,000 square feet of tube surface and was built by Henry R. Worthington. The air is removed by a rotative dry vacuum pump, similar as regards the air end to those heretofore described, but driven through the medium of a silent chain by an electric motor.

The working model concentrating plant built by the Allis-Chalmers Co., which forms one of the most interesting features of the State of Utah exhibit in the Mines and Metallurgy Building, at the St. Louis Fair, is to be presented to the Utah School of Mines after the close of the Exposition. Every separate part of the plant has been lettered with descriptive legends, so that the onlooker, as he watches the plant at work, will be able not only to see what is being done but will also be able to learn the name of the part that does the work. This makes the plant much more interesting as an exhibit and will add greatly to its value as an adjunct to the Utah School of Mines.

—The Northern Pacific Railway has issued a book entitled "Wonderland, 1904," descriptive of the territory traversed by this road, which is full of beautiful illustrations, and has sections devoted to the Yellowstone Park, the Haunts of Wild Game, the Lignite Coal Area in North Dakota, Irrigation in the Northwest, the Travels of Lewis and Clark, and other subjects. This railroad also issues a pamphlet on the Yellowstone National Park, with maps and illustrations, showing how to get there and what to see there. These publications are supplied for six cents and two cents, respectively, by the Passenger Department of the Northern Pacific Railway, St. Paul, Minn.

—An extensive and comprehensive exhibit of mine models, maps, photographs, literature of mining, metallurgy, etc, is being made in the Mines and Metallurgy Palace, at the Louisiana Purchase Exposition, St. Louis. Included in this display are the following: Maps, charts, photographs and models illustrating geologic or topographic features, and their relation to mineral deposits, or the structure or mode of occurrence of mineral deposits. Mine models, working plans of mines; maps, photographs, etc., of mining operations, plants, camps, etc. Statistics and publications relative to geology, mineralogy, palaeontology, topography, quarrying, mining, metallurgy, and the manipulation of mineral products, the development of water resources, etc.

—Josephus Plenty, of Jersey City, has recently closed contracts for skylight work, as follows: International Steam Pump Works, Harrison, N. J., Bert L. Baldwin, engineer, 93,000 square feet; Lehigh Valley R. R. shops, Sayre, Pa., Walter G. Berg, chief engineer, 75,000 square feet; National Tube Co., Lorain, Ohio, E. D. Mower, superintendent of construction, 40,000 square feet; Central R. R. of New Jersey train shed, Jersey City, N. J., 12,000 square feet; League Island Navy Yard, Philadelphia, Pa., 6,000 square feet.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Centrifugal Pumps.

Bulletin No. 9, containing a report by Professors J. E. Denton and William Kent on tests of De Laval centrifugal pumps, two driven by De Laval steam turbines and one by an electric motor, with illustrations, curves and tables. 9 by 6 in.; pp. 24. De Laval Steam Turbine Co., Trenton, N. J., and 74 Cortlandt St., New York.

Circuit Breakers.

Catalogue No. 19043, containing illustrations and descriptions of automatic circuit breakers in different styles and for various uses with both alternating and direct current. 10½ by 7½ in.; pp. 14. Also, circulars Nos. 19046 and 19047, devoted, respectively, to ceiling and fan controllers and to a "variable speed motor" controlling panel which fulfills U. S. Government specifications. Ward Leonard Electric Co., Bronxville, N. Y.

Electric Apparatus.

Bulletins Nos. 4381 and 4382, containing, respectively, illustrations and descriptions of small-plant alternating-current switchboards for 1150 and 2300 volts and of Thomson inclined-coil portable indicating instruments. 10½ by 8 in.; pp. 4 and 8. Also, flyers devoted to enclosed fuse cut-outs, small direct-current generators, direct-current ceiling fan motors, and ready-made electric-lighting outfits for decorative lighting. General Electric Co., Schenectady, N. Y.

Electric Driving.

Bulletin No. 218, devoted to the industrial application of Sprague electric motors for direct-current circuits, with many illustrations showing these motors as geared, belted and direct connected to machine tools, pumps, printing presses, looms, blowers, hoists, winches and other machines. 10½ by 8 in.; pp. 32. Sprague Electric Company, 527-531 West 34th St., New York.

Booklet No. 41, containing illustrations and descriptions of "Northern" electric motors and other apparatus on exhibition at the St. Louis World's Fair, in the Electricity Building and elsewhere, the motors driving machinery of every variety. Also, map of the Fair grounds. 6 by 3½ in.; pp. 16. Northern Electrical Mfg. Co., Madison, Wis.

Electric Hoists.

Catalogue No. 046, containing illustrations and descriptions of electric hoists, winches and capstans in various styles, for direct or alternating currents. 9¼ by 6¾ in.; pp. 20. C. W. Hunt Company, West New Brighton, Staten Island, N. Y.

"Four Powers."

"The Book of the Four Powers," a handsome pamphlet briefly setting forth the scope of the Allis-Chalmers manufactures, including steam engines, water turbines and other hydraulic machinery, gas engines, electric generators and motors, mining machinery, saw mills, and other products, illustrated with artistic half-tones, and with a tastefully designed cover. 10½ by 8 in.; pp. 46. Allis-Chalmers Company, Chicago.

Gas Engines.

Pamphlet, containing illustrations and description of the Sargent complete-expansion gas engine, which possesses many features of special merit, with an account of its method of operation and indicator diagrams. The engines are furnished in units of from 100-horse power up, in single-cylinder-tandem and twin-tandem styles, and for all purposes. 9 by 6 in.; pp. 16. The Wellman-Seaver-Morgan Co., Cleveland, O.

Gasoline Engines.

Catalogue No. 14, containing illustrations and description of high grade gas and gasoline engines adapted to all power purposes, portable gasoline engines on steel and on wooden trucks, a portable electric power plant operated by a gasoline engine, patent revolving wipe contact electric igniter, geared governor, and other details and accessories, views of the Foos shops, useful data, telegraph code and index. 8 by 10½ in.; pp. 39. Also, circular No. 65, showing, in convenient form, the many points of advantage found in the Foos engines. 9 by 6 in.; pp. 4. The Foos Gas Engine Co., Springfield, O.

Gas Producers.

Catalogue, containing illustrations and description of the Morgan continuous gas producer, equipped with the George automatic feed for distributing the coal evenly, uniformly and continuously over the whole surface of the fire. The producers supply gas fuel for iron and steel industries, glass manufacture, ore roasting, brick burning, lime burning, annealing, chemical manufacturing, and any operations involving heating. 9 by 6 in.; pp. 14. Morgan Construction Co., Worcester, Mass.

"St. Louis Exposition Edition" of catalogue containing illustrations and descriptions of producer-gas power plants of the pressure and the suction types, and on the Mond system, with or without by-product recovery. 11 by 8½ in.; pp. 12. R. D. Wood & Co., Philadelphia.

Handling Machinery.

Large book, bound in flexible cloth, with handsome half-tone illustrations on heavy paper and descriptions of the McMyler machinery for the rapid loading and unloading of cars and vessels, including machines for dumping cars bodily, revolving cranes, trolley direct unloaders and bridge tramways, buckets, and other kinds of hoisting and conveying machinery. 11¾ by 9 in.; pp. 55. The Dodge Coal Storage Company, Nicetown, Philadelphia.

Inspection Car.

Catalogue No. 112, containing illustrations and specifications of the Oldsmobile railroad inspection car, with gasoline engine, and testimonials from railroad men who have used it. 9 by 6 in.; pp. 8. Railway Appliances Co., Old Colony Building, Chicago.

Inspirator.

Pamphlet, containing illustrations, description and price list of parts of the Hancock inspirator, type E, universally interchangeable, for feeding locomotive boilers with diagrams showing limiting temperatures and capacities of feed water. 12 by 9 in.; pp. 6. The Hancock Inspirator Company, 85 to 89 Liberty St., New York.

Locomotives.

"Record of Recent Construction," No. 48, containing handsome illustrations and descriptions in English and French of various types of locomotives built for United States and foreign railroad companies and industrial establishments, and the U. S. Government ordnance proving grounds at Sandy Hook. 6 by 9 in.; pp. 32. Baldwin Locomotive Works, Philadelphia.

Machine Tools.

Catalogue, containing illustrations and descriptions of hollow hexagon turret lathes and screw machines, universal turret lathes, valve milling machines, automatic boring and tapping machine, key lathes, cutting-off machine, vertical turret machine, horizontal boring machine, and other high-grade machine tools and appliances for working iron and brass. 9 by 6 in.; pp. 59. The Warner & Swasey Co., Cleveland, O.

Nozzle.

Pamphlet containing a reprint of a thesis by H. C. Crowell and G. C. D. Lenth, of the Civil Engineering Department of the Massachusetts Institute of Technology, on "An Investigation of the Doble Needle Regulating Nozzle," showing the distribution of the velocity and the high efficiency of the jet from this nozzle, with illustrations, diagrams and tables. 9 by 6 in.; pp. 30. Abner Doble Company, San Francisco.

Pneumatic Tubes.

Pamphlet, containing a reprint of an article in *Compressed Air*, by Edmond A. Fordyce, describing and illustrating the very complete and efficient pneumatic-tube system installed at the New York Stock Exchange by the Lamson Consolidated Store Service Company. 9 by 6 in.; pp. 7. Also, folder with illustrations of pneumatic tube systems and electric, spring and gravity cash and parcel carriers. 9 by 4½ in.; pp. 11. Lamson Consolidated Store Service Co., Boston.

Pumping Engines.

Bulletin L 601, containing illustrations and comprehensive descriptions of Meyer-gear pumping engines and their details for small waterworks and elevator service. These engines are built in the cross-compound and three-cylinder-compound types, and with fork frames or rolling-mill frames, and possess many advantages. 9 by 6 in.; pp. 20. Laidlaw-Dunn-Gordon Co., 114 Liberty St., New York.

Refrigerating Machinery.

Catalogue, containing descriptions and illustrations of small ammonia compressors and other apparatus for use in small cold storage plants, with approximate cost of operation and other useful information. 6 by 9 in.; pp. 29. United Iron Works Co., Springfield, Mo.

Shapers.

Catalogue B, containing half-tone illustrations and descriptions of the most modern styles of shaping machines, both belt and motor driven, and of their parts and attachments; together with telegraph code. 9 by 6 in.; pp. 36. Gould & Eberhardt, Newark, N. J.

Steam Engineering School.

Pamphlet with illustrations and descriptions of the State Steam Engineering School, conducted by James Coyne, M.E., whose specialty is the preparation of engineers and firemen for examination for licenses. 5 by 7 in.; pp. 20. State Steam Engineering School, Boston, Mass.

Steam-Pipe Covering.

Pamphlet containing a reprint of a paper by H. G. Stott before the Association of Edison Illuminating Companies, on "Steam-Pipe Covering and its Relation to Station Economy," giving an account of tests made for the Manhattan Railway Co.'s great power house in New York, as a result of which Carey's 85 per cent. carbonate of magnesia coverings were installed. 9 by 6 in.; pp. 12, diagrams, 4. Philip Carey Mfg. Co., Lockland, Station R, Cincinnati.

Thermit.

Pamphlets containing illustrated instructions for welding iron and steel pipes, shafts, girders and other parts and shapes by means of the Goldschmidt thermit process, in which intense heat is generated by the combustion of a mixture of powdered aluminum and other substances. Also, price lists. 9 by 5¾ in.; pp. 12 and 8. Goldschmidt Thermit Co., 43 Exchange Place, New York.

Time Stamp.

Folders with illustrations and descriptions of time stamps which are portable, automatic, self-inking, compact, simple and practical, and which record the hour and minute as well as the date. 6 by 3½ in.; pp. 6. Perry Time Stamp Company, 72 S. Canal St., Chicago.

Valves.

Pamphlet containing illustrations and descriptions of the Forster patent water-sealed reversing valve for regenerative gas furnaces, open-hearth furnaces, crucible furnaces, soaking pits, and so on, with list of users. 9 by 6 in.; pp. 12. The Wellman-Seaver-Morgan Company, Cleveland, O.

Water-Wheel Governors.

Bulletin No. 5, illustrating and describing the Sturgess self-contained water-wheel governors, in which the governor and the pump are both mounted upon the same base, the latter being a hollow cylinder containing the oil under pressure which operates the governor. 9 by 6 in.; pp. 4. Sturgess Governor Engineering Co., Watervliet, N. Y.

NEWS SUPPLEMENT

The Engineering Magazine—November, 1904

Coming Society Meetings.

AMERICAN INSTITUTE OF ARCHITECTS. Sec.: Glenn Brown, Washington, D. C. Annual convention, Dec. 15-17, at Washington.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Sec.: Ralph W. Pope, 95 Liberty St., New York. Meetings on fourth Friday of each month at Carnegie Hall, 154 W. 57th St., New York. Subject for Nov. 26: "Heavy Electric Traction."

AMERICAN INSTITUTE, POLYTECHNIC SECTION. Sec.: George Whitefield, Jr., 19 W. 44th St., New York. Meetings on first and third Tuesdays of each month, from October to May, inclusive.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Sec.: C. W. Hunt, 220 W. 57th St., New York. Regular meetings. first and third Wednesdays of each month.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Sec.: Prof. F. R. Hutton, 12 W. 31st St., New York. Annual meeting, Dec. 6, at New York.

BOSTON SOCIETY OF CIVIL ENGINEERS. Sec.: S. E. Tinkham, 715 Tremont Temple. Regular meetings on third Wednesday of each month, except July and August.

BROOKLYN ENGINEERS' CLUB. Sec.: J. Strachan, 191 Montague St. Regular meetings on second Thursday of each month.

CANADIAN RAILWAY CLUB. Sec.: W. H. Rosevear, Jr., Montreal. Regular meetings on first Tuesday of each month, except June, July and August.

CANADIAN SOCIETY OF CIVIL ENGINEERS. Sec.: Prof. C. H. McLeod, 877 Dorchester St., Montreal. The General Section and the Electrical, Mechanical and Mining Sections meet on different Thursdays, from October to May.

CENTRAL RAILWAY CLUB. Sec.: Harry D. Vought, 62 Liberty St., New York. Regular meetings on second Friday of January, March, May, September and November, Hotel Iroquois, Buffalo.

CHICAGO ELECTRICAL ASSOCIATION. Sec.: W. B. Hale, Monadnock Building. Regular meetings on first and third Fridays of each month, from October to May.

CIVIL ENGINEERS' CLUB OF CLEVELAND. Sec.: Joseph C. Beardsley, 689 The Arcade. Regular meetings on second and fourth Tuesdays of each month.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL. Sec.: G. S. Edmondstone. Regular meetings on second Monday of each month.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Sec.: E. W. Poole, Bridgeport. Annual meeting in November.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Sec.: D. Fleming, Harrisburg, Pa. Annual meeting, Dec. 2 and 3, at New York.

ENGINEERING ASSOCIATION OF THE SOUTH. Sec.: Robt. L. Lund, 2102 Hayes St., Nashville, Tenn. Regular meetings on second Thursday of each month at the Berry Block.

ENGINEERS' CLUB OF CHICAGO. Sec.: B. W. Thurtell, 1223 New York Life Building. Regular meetings on first and third Tuesdays of each month.

ENGINEERS' CLUB OF CINCINNATI. Sec.: C. H. Meeds, P. O. Box 333. Regular meeting on third Thursday of each month, except July and August.

ENGINEERS' CLUB OF COLUMBUS (OHIO). Sec.: H. M. Gates, 5½ West Broad St. Regular meetings on third Saturday of April, May, June and September, and on first and third Saturdays from October to March, inclusive.

ENGINEERS' CLUB OF MINNEAPOLIS. Sec.: Jas. B. Gilman, American Bridge Co. Regular meetings on third Monday of each month, except July and August.

ENGINEERS' CLUB OF PHILADELPHIA. Sec.: J. O. Clarke, 1122 Girard St. Regular meetings on first and third Saturdays of each month, except July and August.

ENGINEERS' CLUB OF ST. LOUIS.. Sec.: H. J. Pfeifer, 920 Rialto Bldg. Regular meetings on first and third Wednesdays of each month.

ENGINEERS' SOCIETY OF WESTERN NEW YORK. Sec.: H. B. Alverson, 533 Ellicott Square, Buffalo. Regular meetings on first Tuesday of each month, except July and August.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. Sec.: Chas. W. Ridinger, 410 Penn Ave., Pittsburg. Regular meetings on third Tuesday of each month.

FRANKLIN INSTITUTE. Sec.: Dr. Wm. H. Wahl, 15 South 7th St., Philadelphia, General meetings on third Wednesday of each month, except July and August. General section meetings every Thursday.

HONOLULU ENGINEERING ASSOCIATION. Sec.: G. F. Bush, Honolulu, Hawaii.

INDIANA PUBLIC UTILITIES ASSOCIATION. Sec.: A. M. Barron, South Bend, Ind. Next meeting, Oct. 18, at Minneapolis.

INTERNATIONAL RAILWAY CONGRESS. General Sec.: Louis Weissenbruch, Belgian State Railways, Brussels, Belgium. Sec. of American Section: W. F. Allen, 24 Park Place, New York. Seventh session, May 3-15, 1905, at Washington.

IOWA RAILWAY CLUB. Sec.: P. B. Vermillion, Des Moines, Iowa. Regular meetings on third Tuesday of each month.

LOUISIANA ENGINEERING SOCIETY. Sec.: G. W. Lawes, 806 Gravier St., New Orleans. Regular meetings on second Monday of each month.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Sec.: Charles S. Clark, 70 Kilby St., Boston. Meetings second Wednesday of each month, except July and August.

MONTANA SOCIETY OF ENGINEERS. Sec.: Clinton H. Moore, Butte, Mont. Regular meetings on second Saturday in each month.

NEW ENGLAND RAILROAD CLUB. Sec.: Edw. L. Janes, Back Bay P. O., Boston. Regular meetings, second Tuesday in each month, at Pierce Hall, Copley Square.

NEW ENGLAND STREET RAILWAY CLUB. Sec.: J. H. Neal, 101 Milk St., Boston. Meetings on last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Sec.: Geo. H. Guy, 114 Liberty St., New York. Meetings monthly, on different Wednesdays, at the American Institute, 19 W. 44th St.

NEW YORK RAILROAD CLUB. Sec.: Harry D. Vought, 62 Liberty St., New York. Regular meetings on third Friday of each month, except June, July and August, at Carnegie Hall, 154 W. 57th St., New York.

NORTH-WEST RAILWAY CLUB. Sec.: T. W. Flannagan, Minneapolis, Minn. Regular meetings on first Tuesday after second Monday of each month, except June, July and August, alternating between Minneapolis and St. Paul.

OHIO SOCIETY OF MECHANICAL ELECTRICAL AND STEAM ENGINEERS. Sec.: Corwin J. Miller, Canton. Next meeting, Nov. 18, at Canton.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Sec.: Geo. P. Low, 237 Cherry St., San Francisco. Annual convention, third Tuesday in June. Intermediate meetings subject to call.

PACIFIC COAST RAILWAY CLUB. Sec.: C. C. Borton, West Oakland, Cal. Regular meetings on third Saturday of each month at San Francisco and other cities.

PACIFIC NORTHWEST SOCIETY OF ENGINEERS. Sec.: Prof. M. Roberts, Seattle. Wash. Meetings monthly in Chamber of Commerce rooms, Seattle.

RAILWAY CLUB OF PITTSBURG. Sec.: J. D. Conway, P. & L. E. R. R. Pittsburg, Pa. Regular meetings on fourth Friday of each month, except June, July and August, at Hotel Henry.

RAILWAY SIGNAL ASSOCIATION. Sec.: B. B. Adams, 83 Fulton St., New York. Regular meetings on second Tuesday of January, March, May, Sept. and Nov.

RAILWAY WATER SUPPLY ASSOCIATION. Sec.: F. W. Hayden, Glencoe, Minn. Meetings on first Sunday of each quarter at Alexander Hall, South Minneapolis, Minn.

RICHMOND RAILWAY CLUB. Sec.: F. O. Robinson, 8th and Main Sts., Richmond, Va. Regular meetings on second Thursday of each month, except June, July and August.

ROCKY MOUNTAIN RAILWAY CLUB. Sec.: M. M. Currier, Colorado City. Regular meetings on second Tuesday of each month, except June, July and August, at Union Depot, Denver.

ST. LOUIS RAILWAY CLUB. Sec.: E. A. Chenery, Union Station, St. Louis. Regular meetings on second Friday of each month, except July and August.

SOCIETY OF CHEMICAL INDUSTRY. NEW YORK SECTION. Sec.: H. Schweitzer, 40 Stone St. Meetings on third Friday after the first Monday of each month, except June, July, August and September, at Chemists' Club, 108 W. 55th St.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB. Sec.: W. A. Love, Atlanta, Ga. Regular meetings on third Thursday of Jan., April, Aug. and Nov., at Atlanta.

TECHNICAL SOCIETY OF THE PACIFIC COAST. Sec.: Otto von Geldern, 31 Post St., San Francisco. Regular meetings on first Friday of each month.

TECHNOLOGY CLUB OF SYRACUSE. Sec.: A. Frederic Witmer, 707 Dillaye Building. Meetings monthly, except in June, July, August and September.

TEXAS RAILWAY CLUB. Sec.: T. H. Osborne, Pine Bluff, Ark. Regular meetings on third Monday of April and September.

TOLEDO SOCIETY OF ENGINEERS. Sec.: L. M. Gram, 519 Gardner Building, Toledo, O. Meetings on third Friday of each month in National Union Building.

WESTERN RAILWAY CLUB. Sec.: J. W. Taylor, 667 Rookery, Chicago. Meetings on third Tuesday of each month, except June, July and August, Auditorium Hotel, Chicago.

WESTERN SOCIETY OF ENGINEERS. Sec.: J. H. Warder, Monadnock Block, Chicago. Regular meetings on first Wednesday and extra meetings on third Wednesday of each month, except July and August.

Personal.

—Mr. Hermann Nieter, of 180 Broadway, New York, is the representative of the Hammond Iron Works, of Warren, Pa.

—Mr. William A. Doble, president of the Abner Doble Company, San Francisco, is a member of the International Jury of Awards, in the Department of Machinery, at the Louisiana Purchase Exposition, St. Louis.

—Dr. Hermann von Schrenk, who is in charge of the Division of Forest Products, of the Bureau of Forestry, and of the Mississippi Valley Laboratory at St. Louis, has

written a number of pamphlets on the diseases of timber and their prevention, on timber preservation and on railroad ties and rail fastenings, all of which are issued by the U. S. Department of Agriculture.

—Mr. G. Fred Collins, who has a very extensive acquaintance throughout the East among officials and engineers of large railroad and steel companies, has recently entered the employ of the Allis-Chalmers Company as special representative at their New York office.

—Mr. D. M. Düller, of 202 Moore Burnett Building, Houston, Texas, has become chief engineer of the American Rice Cereal Co., of Kansas City, Mo., which owns eight irrigation canal systems in Louisiana and Texas.

—Mr. R. C. Routledge, formerly of Messrs. Thomas Smith & Co., of New York, has taken charge of the contract department of the H. W. Johns-Manville Co., of 100 William St., New York, to which he will give his undivided attention.

—Mr. Spencer Miller, chief engineer of the Lidgerwood Mfg. Co., of New York, has returned from St. Petersburg, where he went by request of the Russian Government to inspect ten Lidgerwood marine cableways which they had installed upon the ten largest battleships and cruisers of the Baltic Fleet, known, however, in Russia as the Second Pacific Squadron, and the sailing of which has been a matter of much discussion in the daily press for months past.

—Messrs. Erskine Ramsay and Charles E. Bowron, who have both had many years' experience as engineers and managers of mining and metallurgical plants in the Birmingham, Ala., district, have formed the firm of Ramsay and Bowron, at 2024½ First Ave., Birmingham, Ala., for general engineering practice, making a specialty of examinations and reports of Southern plants and properties, and of plans and estimates for mining plants, coke ovens and similar works.

Industrial Notes.

—The Association of Licensed Automobile Manufacturers have issued a Hand-Book of Gasoline Automobiles, for the information of the public who are interested in the manufacture and use of these vehicles, and primarily for the convenience of the prospective purchaser of an automobile. The machines of the principal American manufacturers and of the importers of the leading foreign gasoline automobiles are shown in handsome half-tone illustrations, accompanied by specifications. These specifications include the principal features of the machine and are printed in black and red, in uniform style, so that the characteristics of the different automobiles can be very easily compared, the prices being also given. The automobiles shown include all varieties, from the racing machine and the heavy, elaborately fitted touring car, to delivery wagons, runabouts and buckboards. The hand-book is most tastefully and attractively gotten up, and will appeal to everyone interested in automobiles. It may be obtained by sending six cents in postage stamps to the Association of Licensed Automobile Manufacturers, 7 East 42d St., New York.

—The Reeves Engine Company have received an order from Messrs. S. Pearson & Sons, Inc., for six vertical cross-compound engines, which are to supply the light and power for the Pennsylvania Railroad Co.'s East River tunnel. Three of them will be installed on the New York side, and three on the Long Island side. The Reeves Engine Company have also received orders for seven vertical cross-compounds for the Columbus (Ohio) sewage disposal plant, and for three engines of the same type from The William Tod Company, of Youngstown, Ohio, for the Youngstown sewage disposal plant, all of these engines being for direct connection to centrifugal pumps.

—Keuffel & Esser Co., of 127 Fulton St., New York, have a very large, complete and interesting exhibit at the St. Louis Exposition of the products of their factories, which are the largest of their kind in America and perhaps the largest in the world. The exhibit consists of surveying instruments of all kinds, drafting instruments, devices for mathematical calculations, furniture for the drafting room, blue-printing material and apparatus, including frames for printing by electric light, nautical instruments, such as binnacles, sextants, compasses, etc., instruments for forest surveying and other forestry work (a

new industry in this country), measuring tapes in great variety, and a number of very interesting special instruments for military purposes, such as Keuffel & Esser Co. furnish to the U. S. Army and Navy. The articles are displayed in and about an ornamental pavilion near the center of the Palace of Liberal Arts, the nautical instruments being placed on an imitation ship with a pilot house. The exhibit occupies over 1,500 square feet of floor space and is both artistically and systematically arranged, the apparatus being grouped in an orderly manner which facilitates inspection and study.

—The E. M. Dart Manufacturing Co., of Providence, R. I., report that the year just past has been the most prosperous one in their history, and that they have considerably increased the output of their patent union couplings, which the year before was about 500,000.

—Mr. D. O. James, who was a member of the firm of James & Foote, manufacturers of cut gears, whose plant was damaged by fire last June, has sold his interest in the tools and machinery saved from the conflagration to Mr. Foote, and has started a new business on his own account. Mr. James is now located at 35 and 37 South Canal St., Chicago, where he has a modern shop equipped with the latest and most improved machinery for making spur gears, bevel gears with planed teeth, internal gears, spiral gears and worm gears.

—The Reeves Engine Co., of 85 Liberty St., New York, closed orders for thirty-six of their engines during September. Recent tests of a Reeves engine, made by Professors R. C. Carpenter and H. Diederichs, at Sibley College, Cornell University, gave very interesting and satisfactory results.

—The Ball Engine Co., of Erie, Pa., are in receipt of an order for two 1,000-horse-power horizontal cross-compound Corliss engines, direct connected to alternators, for the People's Ice, Light & Storage Co., of McKeesport, Pa., and have also recently received many other orders for their engines from all parts of the country.

—The Stirling Company, of Chicago, the manufacturers of water-tube safety boilers, have appointed Mr. Frederick A. Scheffler special representative, with headquarters at their New York office in the Engineering Building, 114 Liberty St., New York. Mr. Scheffler will be associated with Mr. A. L. Rogers, the district sales manager, and any inquiries regarding the Stirling water-tube boiler will receive prompt and energetic attention.

—The Wellman-Seaver-Morgan Company, engineers and manufacturers, with general offices at Cleveland, Ohio, and plants at Cleveland and Akron, Ohio, have opened a New York office at 42 Broadway. Mr. Geo. B. Damon, who is a well known and able engineer, has been appointed New York manager, and any inquiries addressed to the New York office will have his immediate and personal attention.

—The Bristol Company, of Waterbury, Conn., have an exhibit at the St. Louis Exposition of recording instruments for pressure, temperature and electricity, located in the Electricity Building. The booth, which is 21 feet by 12 feet, and looks very attractive, contains a large variety of instruments which record continuously with ink, upon graduated, revolving charts, all changes that occur in pressure, temperature or electricity, so that a record of a period of 24 hours or more may be observed at a glance. Many of these instruments are in actual operation, and may be inspected by visitors to learn their manner of construction and the scientific principles upon which their operation depends, and the extreme sensitiveness and accuracy that it is possible to obtain in instruments of this character without rendering them too delicate for commercial application. Recording pressure gauges are shown for ranges from full vacuum to 10,000 pounds per square inch; recording thermometers and pyrometers for ranges from 60° F. below zero to 1200° F. above. The recording thermometers are made in many varieties of form to render them applicable to all industrial requirements, especially where it is desired to record temperatures at a distance from the source of heat. Recording volt, ampere and watt meters for both alternating and direct current are shown, including a great variety of ranges suited to commercial demands for different voltages and currents in electric light, power and railway plants. Recording water-level gauges are shown in operation, and also a new instrument designed as a thermom-

eter-thermostat. This last instrument is so constructed that it may be used to give an alarm or set in operation temperature-regulating apparatus at any predetermined point of temperature. A full line of sizes of Bristol's patented steel belt lacing is also exhibited and includes styles for all varieties and thicknesses of belting.

—The Brown Corliss Engine Co., of Corliss, Wis., have recently received orders for one 24 and 44 by 48-inch tandem-compound rolling-mill engine for the U. S. Steel Corporation's McKeesport plant, near Pittsburg, and for one 30 and 60 by 48-inch tandem-compound condensing engine for the rolling-mill plant of the Jones & Laughlin Steel Co., of Pittsburg.

—The Wile Power Gas Company has been formed in Rochester, N. Y., to deal in gas producers for power and heating. This company will manufacture automatic gas producers, with patent regulator of the pressure type, of which over 1,000 horse power are now in successful operation in England. These producers will work with either coke, charcoal, anthracite coal, bituminous coal or wood. The Wile Power Gas Co. will also build suction gas producers designed by experienced gas engineers and embodying the best features of European practice.

—The American Blower Co., of Detroit, have recently opened a branch office at 1019 Empire Building, Atlanta, Ga.

—The electric wires in the cars on the N. Y. Rapid Transit Subway will run through the Sprague Company's flexible metallic conduit, which is extensively used in the best and most modern buildings throughout the country. Flexible metallic conduit is a tube formed by a succession of steel convolutions, which gives not only great flexibility to the tube, but, also, by reason of the metal composition, a thorough protection to the insulated wires which it carries. Injury from rodents or mechanical causes is thus prevented, and even a short circuit will produce no serious damage, so that safety to the passengers is insured and they have nothing to fear from fire caused by defective wiring.

—The Crocker-Wheeler Company, of Ampere, N. J., have seven of their standard railway-type generators, compound wound for 550 volts, in the Intramural Railway power plant, in Machinery Hall, at the St. Louis Exposition, in the following sizes: One 900-kilowatt unit, connected to an engine manufactured by the Buckeye Engine Co., of Salem, O.; one 600-kilowatt unit, driven by an engine of the Lane & Bodley Co., Cincinnati; one 500-kilowatt unit, with an engine made by the Murray Iron Works Co., Burlington, Iowa; two 500-kilowatt units, driven by engines of the Brown-Corliss Engine Co., Corliss, Wis.; one 400-kilowatt unit, with an engine from the Harrisburg Foundry & Machine Co., of Harrisburg, Pa.; and one 100-kilowatt unit, driven by a tangential water-wheel of the Abner Doble Company, San Francisco. These generators and engines, which have been in service but a short time, are all for sale, delivery to be made shortly after January 1, 1905.

—The Miami Commercial College, of Dayton, Ohio, has issued on attractive pamphlet, describing its course of study and showing the remarkable success achieved by its graduates, letters from many of whom are reproduced. This institution was established in 1860, and its principal officers at present are A. D. Wilt, president, A. D. Wilt, Jr., vice-president, and S. O. Albaugh, secretary.

—A meeting of a number of persons interested in cement and cement construction was held in St. Louis during the Engineering Congress, at which reports were made of the results of a canvass on the question of the formation of an association composed of users of cement. Several editorials have appeared in magazines suggesting such an association, especially in the September and October numbers of *Municipal Engineering*, published in Indianapolis. Circular letters have been sent to persons engaged in cement and concrete construction, especially in concrete block manufacture, asking for expressions of opinions regarding the time and place of meeting for the formation of such an association. A large number of replies to the circular letters have been received and as a result of this vote, it was decided at the meeting referred to, to issue a call for the convention of users of cement at Indianapolis, January 17-18-19, 1905. Arrangements were made for securing competent persons to speak upon the various subjects which

will come up for discussion, and to arrange for the local entertainment of the convention, so that it may be successful in all its details. Further information regarding this convention may be obtained from Mr. Charles C. Brown, of 82 Commercial Club Building, Indianapolis.

—The Electric Controller & Supply Co., of Cleveland, announce the opening of their southern branch office at 509-510 Woodward Bldg., Birmingham, Ala. This company is now represented in the following cities: New York, Philadelphia, Pittsburg, Cleveland, O., Birmingham, Ala., Denver, Colo., San Francisco, and London.

—The Northern Electrical Mfg. Co., of Madison, Wis., recently shipped to the New York Edison Co. 34 of its variable-speed motors operating on the Northern two-wire field-control system. These motors will be directly coupled to blowers for cooling the transformers in the various sub-stations of the Edison Company. Nine small Northern motors were also shipped recently to be installed in the sub-stations of the Brooklyn Rapid Transit Co. This makes a total of 75 Northern motors, aggregating 1,500 horse power, now in use by the two above-named companies. A 60-kilowatt Northern balancing set has also been shipped to the New York Edison Co., for the equipment of its Waterside Station.

—The Power & Mining Machinery Company have recently closed a contract with Mr. James E. Hooper, of Baltimore, for a 25 by 30-inch, two-cylinder engine, and two suction gas producers, the plant to be installed in his new cotton mill at Woodberry, Baltimore. The engine as installed will have three rope pulleys for driving to the floors of the mill, and the shaft will be extended for a flanged coupling, so that another 25 by 30-inch, two-cylinder engine can be installed at a later date, it being Mr. Hooper's intention to double the mill after the first half is in operation. It is believed that this is the first installation of its kind for cotton mill work. The order was obtained after a very thorough investigation on the part of Mr. Hooper and his engineer, Mr. C. C. Hedrick, of the Lowell Machine Company.

—S. Pearson & Son, Incorporated, who are building the Pennsylvania Railroad tunnels under the East River and Long Island City, have just awarded the contract for two complete compressed-air power plants, ready to operate, to the Ingersoll-Sergeant Drill Company, of New York. The combined capacity of the plants consists of 50,000 cubic feet of low-pressure air per minute, and 12,000 cubic feet of high-pressure air per minute. It will be remembered that the same company recently received an order from the O'Rourke Engineering & Construction Company for the compressed-air plants to be used in building the Pennsylvania tunnel under the Hudson River. The contract just awarded is the largest order ever placed in the history of the business. These plants will be erected by the Ingersoll-Sergeant Drill Company, under the personal supervision of Mr. J. H. Jowett, the sales manager of the company.

—The New York Continental Jewell Filtration Company, of 15 Broad St., New York City, have an active demand for their water-purifying apparatus. Among their recent sales are the following: To apartment houses, residences, office buildings, etc.: Grand Hotel, Caledonia Springs, Quebec, Canada; St. Joseph's Hospital, Ft. Wayne, Ind.; New York Telephone Company, New York; N. Y. Magdalen Benevolent Society, Inwood, N. Y.; Racquet and Tennis Club, New York; Dr. Reginald Allen, J. C. Wilson, S. Geikler, Thos. W. Eynon, Mrs. Isaac Starr, Miss M. Grace Hall, C. J. String, Miss Hubbell, Rev. E. S. Lowery, W. H. Farwell, C. J. Hatfield, Mrs. Wm. McLean and Philip Wright, all of Philadelphia. To textile mills: Chas. H. Whitly & Brother, Philadelphia; A. H. Sims Company, Montreal, Canada; Laurens Cotton Mills, Laurens, S. C.; and P. & J. Coates Company, Ltd., Pawtucket, R. I. Miscellaneous: Eynon & Evans, (brass foundry), Philadelphia; Rotograph Company, New York; J. A. Roebling's Sons Co., Trenton, N. J., a second order; W. H. Tolhurst & Son, Troy, N. Y.; Lehigh Valley Railroad Company, Easton, Pa.; Freund Brothers, (photographers), Atlantic City, N. J.; Peter Breidt City Brewery Company, Elizabeth, N. J.; Crystal Ice & Power Company, (ice plant), Danville, Va.; Jerome Avenue Pumping Station, (boiler service), New York; R. H. H. Steele Laundry, Jersey City, N. J.; and The Orr Company, Troy, N. Y.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Aerial Tramways.

Pamphlet, containing illustrated descriptions of the Otto aerial wire-rope tramways for the transport of coal, ore, timber and other materials, in buckets, boxes, casks and chains, with views of installations in all parts of the world, these tramways running up 20 miles in length and having clear spans up to 3657 feet. 9 by 6 in., pp. 46. Otto Wire Rope Tramway Co., 225 Washington St., Chicago.

Ammonia Fittings.

Catalogue No. 2, containing illustrations, descriptions and prices of ammonia valves, flanges, couplings, elbows, tees, bends, headers, piping, safety gauge glasses and other ammonia fittings for ice-making and refrigerating plants. 9 by 6 in.; pp. 28. Vulcan Iron Works, San Francisco.

Ball Bearings.

Bulletins Nos. 1, 5 and 6, devoted to Auburn ball bearings, including ball thrust bearings, ball thrust washers and other styles, together with many testimonials from users. 9 by 4¼ in. Auburn Ball Bearing Co., Rochester, N. Y.

Building Construction.

Pamphlets describing and illustrating the rapid and efficient construction of the electrical engineering laboratory for the Massachusetts Institute of Technology, a plant for the Columbia Rope Co., of Auburn, N. Y., a concrete dam, power stations, hospitals, and other buildings and engineering works. 7 by 8 in. Frank B. Gilbreth, 176 Federal St., Boston.

Cableways.

Large and comprehensive catalogue, with half-tone illustrations and descriptions of various forms of cableways for coaling at sea, loading and discharging vessels, handling logs, open-pit mining and quarrying, and constructing canals, dry docks, dams, locks, filter beds, piers and other engineering works. 11½ by 9 in.; pp. 160. Lidgerwood Manufacturing Co., 96 Liberty St., New York.

Coal-Handling Machinery.

Bulletin No. 047, illustrating and describing coal-handling machinery for power stations, boiler rooms, coaling stations, gas companies, coal yards, shipping docks, manufactories and other places. 5½ by 6¾ in.; pp. 48. C. W. Hunt Company, West New Brighton, Staten Island, N. Y.

Concrete-Steel Bridges.

Pamphlet, containing illustrations of many handsome reinforced concrete arch bridges, for parks, highways and railways, built on the Melan, the Thacher and the von Emperger systems. 5½ by 8 in.; pp. 36. Concrete Steel Engineering Co., Park Row Building, New York.

Electric Driving.

Bulletin No. 37, containing an account, with many illustrations, of the Northern variable-speed motor drive for machine tools, a system with a single-voltage electric motor operating on a two-wire circuit through a controller, thereby obtaining speed variations of 5 and 6 to 1. 10 by 7 in.; pp. 12. Northern Electrical Manufacturing Co., Madison, Wis.

Electric Generators.

Bulletin No. 49, containing illustrations and descriptions of seven standard Crocker-Wheeler railway-type generators, ranging from 900 to 100 kilowatts in capacity, six driven by steam engines and one by a Doble water wheel, which are in the power plant of the Intramural Railway at the St. Louis Exposition, and will be sold at the close of the Fair. 7½ by 5 in.; pp. 16. Crocker-Wheeler Company, Ampere, N. J.

Electric Machines.

Bulletin No. 1027, illustrating and describing alternating current generators and motors, of both belted and direct-coupled types, and their parts, with views of plants where they are installed. 9 by 6 in.; pp. 16. The Bullock Electric Mfg. Co., Cincinnati.

Expanded Metal.

Large, handsome pamphlet containing half-tone illustrations and descriptions of the expanded-metal system of fireproof building construction for floors, roofs, partitions, ceilings, columns, walls, cornices, etc., theoretical and practical discussion of this method of construction, and views of many buildings and engineering works where it is employed. 12 by 9 in.; pp. 64. Expanded Metal Engineering Co., 256 Broadway, New York.

Fire Extinguisher.

Booklet, illustrating and describing Badger's fire extinguisher, which is compact and convenient, and by means of which a stream of water impregnated with carbonic acid gas can be thrown on a fire without delay. 6 by 3¼ in.; pp. 16. Badger Fire Extinguisher Co., Boston.

Flexible Transmission.

Bulletin No. 17, giving descriptions and illustrations of the Coates hardened-steel ball-bearing flexible shaft and its applications to drills, grinders and other tools and machines. 8 by 6 in.; pp. 16. Also, circulars devoted to the Coates' direct-drive coupling for automobiles and the Coates' ideal foundry equipment. Coates Clipper Manufacturing Co., Worcester, Mass.

Grab Buckets.

Pamphlet, with illustrations of grab buckets for handling coal, ore, broken limestone, gravel and sand, and for excavating in clay, gravel and soft earth of any nature. 8 by 4½ in.; pp. 12. The Jeffrey Manufacturing Co., Columbus, O.

Inspirators.

Catalogue, containing half-tone illustrations and descriptions of the Hancock inspirator, of the "stationary" and other types, ejectors, noiseless water heaters, swing check valve and their accessories, with views and description of the Hancock Inspirator Co.'s factory, history of the inspirator, and useful information. 6 by 9 in.; pp. 54. The Hancock Inspirator Co., 85-89 Liberty St., New York.

Locomotive Cranes.

Bulletin No. 4, giving comprehensive descriptions and illustrations of "Browning Standard" locomotive cranes, in several styles, and of their details. 9 by 6 in.; pp. 32. The Browning Engineering Co., Cleveland, Ohio.

Machinery.

Pamphlet entitled "What We Do," which gives some idea of the scope of the Wellman-Seaver-Morgan Company's work. There are illustrations and brief descriptions of steel works and steel-works machinery, gas-producer plants, cranes, ore and coal-handling machinery, coke-oven machinery, steam engines, gas engines, water turbines, mining machinery, and other kinds of machinery and engineering works. 9¼ by 4 in.; pp. 36. The Wellman-Seaver-Morgan Co., Cleveland, Ohio.

Mining Machinery.

Bulletin No. 101, containing illustrations and descriptions of electrically-driven air compressors, mining hoists, pumps, blowers and exhausters and other machinery for use at mines, with remarks on electric driving. 9 by 6 in.; pp. 24. Harron, Rickard & McCone, San Francisco.

Narrow-Gauge Railways.

Booklet, containing article entitled "On the Track," by Ernst Wiener, reprinted from *Cassier's Magazine*, and descriptions and illustrations of narrow-gauge railways and cars for industrial works, mines, and many other purposes, both in and out of doors. 6¼ by 3½ in.; pp. 24. Arthur Koppel, 66-68 Broad St., New York.

Plate Construction.

Large pamphlet, containing handsome half-tone illustrations of modern blast-furnace plants, cinder and hot metal cars, steel mixers, and other examples of steel and iron plate construction. 9 by 11 in.; pp. 63. The William B. Pollock Co., Youngstown, Ohio.

Precision Machinery.

Catalogue giving illustrations, construction details and principal dimensions of precision machinery, including bench lathes, with many attachments, automatic pinion cutters, automatic gear cutters, drilling and tapping machines, and bench milling machines. 9 by 5¾ in.; pp. 59. Sloane & Chace Manufacturing Co., Ltd., Newark, N. J.

Pumping Machinery.

Large pamphlet containing an illustrated reprint from *The Iron Age* on "Pumping and Air-Compressing Machinery at the St. Louis Exposition," which describes the pumping plant for the great cascades, sewage pumps, a model irrigation plant, condensing apparatus and cooling towers, compressed-air plants, and many other kinds of pumping machinery. 12½ by 8½ in.; pp. 16. International Steam Pump Co., 114-118 Liberty St., New York.

Catalogue with illustrations and descriptions of condensing machinery, including jet condensers, surface condensers, cooling towers and air pumps of various kinds, as well as vacuum pumps for evaporating apparatus. 7 by 6 in.; pp. 56. Also, "Pony" catalogue No. 44, containing descriptions and illustrations of steam pumps for a great variety of purposes. 6 by 3½ in.; pp. 64. Dean Bros.' Steam Pump Works, Indianapolis.

Recording Electric Meters.

Catalogue No. 16, with illustrations, descriptions and prices of recording volt meters, ampère meters and watt meters, their charts, cases and other accessories, facsimiles of records, tables of dimensions, diagrams of connections and other information. 12 by 9 in.; pp. 40. Also, bulletin No. 17, illustrating the Bristol Company's exhibit at the World's Fair, St. Louis. The Bristol Company, Waterbury, Conn.

Steam Engines.

Pamphlet describing tests of a Reeves simple engine, made by Professors Carpenter and Diederichs at Cornell University, which gave excellent results. 9 by 6 in.; pp. 4. The Reeves Engine Co., 85 Liberty St., New York.

Bulletins Nos. 162, 163 and 171, devoted to vertical steam engines, and Bulletin No. 164, to horizontal engines, with many illustrations, these engines being especially designed for driving blowers and fans. No. 171 also describes a new and effective system of automatic lubrication for vertical high-speed engines. 9 by 7 in. Also, booklet No. 70 devoted to fans and blowers. 4½ by 3½ in.; pp. 32. American Blower Co., Detroit.

Steam Specialties.

Price list No. 11, with illustrated descriptions of "K. & T." pressure regulators, continuous-discharge steam traps, noiseless back-pressure valves, and automatic relief valves, Metz pump governors, Vaters' two-stage steam separators, and other steam specialties. 9 by 6 in.; pp. 8. Klipfel Manufacturing Co., 74-76 W. Lake St., Chicago.

Storage Batteries.

Booklet, containing descriptions, with illustrations and diagrams, of "chloride" accumulators in various styles, for railway power plants, rotary-converter substations, automobiles and other uses, with tables and useful information in convenient form. 3 by 5½ in.; pp. 42. The Electric Storage Battery Co., Philadelphia.

Switchboards.

Bulletin No. 20, containing descriptions, illustrations and prices of "Security" panel boards for electric switches, fuses and connections. 10 by 7¼ in.; pp. 20. Also, card illustrating the "Special" dry battery. The F. Bissell Company, Toledo, Ohio.

NEWS SUPPLEMENT

The Engineering Magazine—December, 1904

Coming Society Meetings.

AMERICAN FOREST CONGRESS. Sec.: Wm. L. Hall, Atlantic Building, Washington, D. C. Meeting under the auspices of the American Forestry Association, Jan. 2 to 6, 1905, at Washington.

AMERICAN INSTITUTE OF ARCHITECTS. Sec.: Glenn Brown, Washington, D. C. Annual convention, Dec. 15-17, at Washington.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Sec.: Ralph W. Pope, 95 Liberty St., New York. Meetings on fourth Friday of each month at Carnegie Hall, 154 W. 57th St., New York. Subject for Dec. 23: Transmission Problems.

AMERICAN INSTITUTE, POLYTECHNIC SECTION. Sec.: George Whitefield, Jr., 19 W. 44th St., New York. Meetings on first and third Tuesdays of each month, from October to May, inclusive.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Sec.: C. W. Hunt, 220 W. 57th St., New York. Regular meetings, first and third Wednesdays of each month, except July and August.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Sec.: Prof. F. R. Hutton, 12 W. 31st St., New York. Annual meeting, Dec. 6-9, at New York.

BOSTON SOCIETY OF CIVIL ENGINEERS. Sec.: S. E. Tinkham, 715 Tremont Temple. Regular meetings on third Wednesday of each month, except July and August.

BROOKLYN ENGINEERS' CLUB. Sec.: J. Strachan, 191 Montague St. Regular meetings on second Thursday of each month.

CANADIAN RAILWAY CLUB. Sec.: W. H. Rosevear, Jr., Montreal. Regular meetings on first Tuesday of each month, except June, July and August.

CANADIAN SOCIETY OF CIVIL ENGINEERS. Sec.: Prof. C. H. McLeod, 877 Dorchester St., Montreal. The General Section and the Electrical, Mechanical and Mining Sections meet on different Thursdays, from October to May.

CENTRAL RAILWAY CLUB. Sec.: Harry D. Vought, 62 Liberty St., New York. Regular meetings on second Friday of January, March, May, September and November, Hotel Iroquois, Buffalo.

CHICAGO ELECTRICAL ASSOCIATION. Sec.: W. B. Hale, Monadnock Building. Regular meetings on first and third Fridays of each month, from October to May.

CIVIL ENGINEERS' CLUB OF CLEVELAND. Sec.: Joseph C. Beardsley, 689 The Arcade. Regular meetings on second and fourth Tuesdays of each month.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL. Sec.: G. S. Edmonstone. Regular meetings on second Monday of each month.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. SEC.: D. Fleming, Harrisburg, Pa. Annual meeting, Dec. 2 and 3, at New York.

ENGINEERING ASSOCIATION OF THE SOUTH. Sec.: Robt. L. Lund, 2102 Hayes St., Nashville, Tenn. Regular meetings on second Thursday of each month at the Berry Block.

ENGINEERS' CLUB OF CHICAGO. Sec.: B. W. Thurtell, 1223 New York Life Building. Regular meetings on first and third Tuesdays of each month.

ENGINEERS' CLUB OF CINCINNATI. Sec.: C. H. Meeds, P. O. Box 333. Regular meeting on third Thursday of each month, except July and August.

ENGINEERS' CLUB OF COLUMBUS (OHIO). Sec.: H. M. Gates, 5½ West Broad St. Regular meetings on third Saturday of April, May, June and September, and on first and third Saturdays from October to March, inclusive.

ENGINEERS' CLUB OF MINNEAPOLIS. Sec.: Jas. B. Gilman, American Bridge Co. Regular meetings on third Monday of each month, except July and August.

ENGINEERS' CLUB OF PHILADELPHIA. Sec.: J. O. Clarke, 1122 Girard St. Regular meetings on first and third Saturdays of each month, except July and August.

ENGINEERS' CLUB OF ST. LOUIS. Sec.: H. J. Pfeifer, 920 Rialto Bldg. Regular meetings on first and third Wednesdays of each month.

ENGINEERS' SOCIETY OF WESTERN NEW YORK. Sec.: H. B. Alverson, 533 Ellicott Square, Buffalo. Regular meetings on first Tuesday of each month, except July and August.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. Sec.: Chas. W. Ridinger, 410 Penn Ave., Pittsburg. Regular meetings on third Tuesday of each month.

FRANKLIN INSTITUTE. Sec.: Dr. Wm. H. Wahl, 15 South 7th St., Philadelphia. General meetings on third Wednesday of each month, except July and August. General section meetings every Thursday.

HONOLULU ENGINEERING ASSOCIATION. Sec.: G. F. Bush, Honolulu, Hawaii.

INTERNATIONAL RAILWAY CONGRESS. General Sec.: Louis Weissenbruch, Belgian State Railways, Brussels, Belgium. Sec. of American Section: W. F. Allen, 24 Park Place, New York. Seventh session, May 3-15, 1905, at Washington.

IOWA RAILWAY CLUB. Sec.: P. B. Vermillion, Des Moines, Iowa. Regular meetings on third Tuesday of each month.

LOUISIANA ENGINEERING SOCIETY. Sec.: G. W. Lawes, 806 Gravier St., New Orleans. Regular meetings on second Monday of each month.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Sec.: Charles S. Clark, 70 Kilby St., Boston. Meetings second Wednesday of each month, except July and August.

MONTANA SOCIETY OF ENGINEERS. Sec.: Clinton H. Moore, Butte, Mont. Regular meetings on second Saturday in each month.

NEW ENGLAND RAILROAD CLUB. Sec.: Edw. L. Janes, Back Bay P. O., Boston. Regular meetings, second Tuesday in each month, except June, July, August and September, at Pierce Hall, Copley Square.

NEW ENGLAND STREET RAILWAY CLUB. Sec.: J. H. Neal, 101 Milk St., Boston. Meetings on last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Sec.: Geo. H. Guy, 114 Liberty St., New York. Meetings monthly, on different Wednesdays, at the American Institute, 19 W. 44th St.

NEW YORK RAILROAD CLUB. Sec.: Harry D. Vought, 62 Liberty St., New York. Regular meetings on third Friday of each month, except June, July and August, at Carnegie Hall, 154 W. 57th St., New York.

NORTH-WEST RAILWAY CLUB. Sec.: T. W. Flannagan, Minneapolis, Minn. Regular meetings on first Tuesday after second Monday of each month, except June, July and August, alternating between Minneapolis and St. Paul.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Sec.: Geo. P. Low, 237 Cherry St., San Francisco. Annual convention, third Tuesday in June. Intermediate meetings subject to call.

PACIFIC COAST RAILWAY CLUB. Sec.: C. C. Borton, West Oakland, Cal. Regular meetings on third Saturday of each month at San Francisco and other cities.

PACIFIC NORTHWEST SOCIETY OF ENGINEERS. Sec.: Prof. M. Roberts, Seattle, Wash. Meetings monthly in Chamber of Commerce rooms, Seattle.

RAILWAY CLUB OF PITTSBURG. Sec.: J D. Conway, P. & L. E. R. R., Pittsburg, Pa Regular meetings on fourth Friday of each month, except June, July and August, at Hotel Henry.

RAILWAY SIGNAL ASSOCIATION. Sec.: H. S. Balliet, South Bethlehem, Pa. Regular meetings on second Tuesday of January, March, May, September and November.

RAILWAY WATER SUPPLY ASSOCIATION. Sec.: F. W. Hayden, Glencoe, Minn. Meetings on first Sunday of each quarter, at Alexander Hall, South Minneapolis, Minn.

RICHMOND RAILWAY CLUB. Sec.: F. O. Robinson, 8th and Main Sts., Richmond, Va. Regular meetings on second Thursday of each month, except June, July and August.

ROCKY MOUNTAIN RAILWAY CLUB. Sec.: M. M. Currier, Colorado City. Regular meetings on second Tuesday of each month, except June, July and August, at Union Depot, Denver.

ST. LOUIS RAILWAY CLUB. Sec.: E. A. Chenery, Union Station, St. Louis. Regular meetings on second Friday of each month, except July and August.

SOCIETY OF CHEMICAL INDUSTRY. NEW YORK SECTION. Sec.: H. Schweitzer, 40 Stone St. Meetings on third Friday after the first Monday of each month, except June, July, August and September, at Chemists' Club, 108 W. 55th St.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB. Sec.: W. A. Love, Atlanta, Ga. Regular meetings on third Thursday of January, April, August and November, at Atlanta.

TECHNICAL SOCIETY OF THE PACIFIC COAST. Sec.: Otto von Geldern, 31 Post St., San Francisco. Regular meetings on first Friday of each month.

TECHNOLOGY CLUB OF SYRACUSE. Sec.: A. Frederic Witmer, 707 Dillaye Building. Meetings monthly, except in June, July, August and September.

TEXAS RAILWAY CLUB. Sec.: T. H. Osborne, Pine Bluff, Ark. Regular meetings on third Monday of April and September.

TOLEDO SOCIETY OF ENGINEERS. Sec.: L. M. Gram, 519 Gardner Building, Toledo, O. Meetings on third Friday of each month in National Union Building.

WESTERN RAILWAY CLUB. Sec.: J. W. Taylor, 667 Rookery, Chicago. Meetings on third Tuesday of each month, except June, July and August, Auditorium Hotel, Chicago.

WESTERN SOCIETY OF ENGINEERS. Sec.: J. H. Warder, Monadnock Block, Chicago. Regular meetings on first Wednesday and extra meetings on third Wednesday of each month, except July and August.

Personal.

—Mr. Charles Lang, formerly with the Wheeler Condenser and Engineering Co., has joined the sales department of the A. D. Granger Co., at their New York office, 95 Liberty Street. Mr. Lang will make a specialty of pumps and condensers, the A. D. Granger Co. having recently acquired the agency for the Barr Pump Company, of Philadelphia.

—Mr. J. W. Duntley, president of the Chicago Pneumatic Tool Company, sailed recently on a short business trip to Europe, where he will start the new plant for the

manufacture of his company's apparatus located at Fraserburgh, Scotland, and will visit the business centers of England, Scotland and the Continent in the interests of the rapidly growing foreign business of the Chicago Pneumatic Tool Company.

Mr. E. D. Grant, who for some time past has been instructor in the department of Mathematics and Physics of the Michigan College of Mines, has recently been made assistant professor in the same department.

—Mr. Edward James, who was for many years connected with the Burt Mfg. Co. and who established their filter business throughout the country, has entered the employ of the Pittsburgh Gage and Supply Co., of Pittsburgh, and will look after the interests of the latter company with regard to their White Star oil filters in all parts of the South and West.

—Mr. Ernst Wiener, of the firm of Arthur Koppel, recently returned from a three months' trip to Europe.

Industrial Notes.

—The American Society of Mechanical Engineers will hold its annual meeting in New York, from Tuesday, Dec. 6th, to Friday, Dec. 9th, inclusive. A number of interesting papers will be read, and the usual reception will be held on Thursday evening, Dec. 8th, at Sherry's. The following nominations have been made by the nominating committee: For president, John R. Freeman; for treasurer, William H. Wiley; for vice-presidents, S. M. Vauclain, H. H. Westinghouse and Fred W. Taylor; and for managers, George M. Brill, Fred J. Miller and Richard H. Rice.

—Keuffel & Esser Co., of New York, who have had such a fine exhibit of their drawing materials, mathematical and surveying instruments and other products at the Louisiana Purchase Exposition, in St. Louis, have been awarded the only grand prize in Group 19, Liberal Arts (comprising instruments of precision, philosophical apparatus, etc.) and a gold medal in Group 115, Mines and Metallurgy (comprising instruments and equipment for underground surveying).

—The Eureka Construction Co., of 287 4th Ave., New York, has entered the field of fireproof building construction under the auspices of men who have made almost a life study, not only of the manufacture of fireproofing material, but as well of its proper and efficient installation. This company purposes to confine its operations chiefly to railroad work, such as car barns, sheds, stations, warehouses, etc., having secured rights under different patents which cover methods peculiarly adapted to such work, among others, the Phœnix wall construction, and the Herculean, Eureka and Peerless systems for floor arches.

—The Thomas S. Clarkson Memorial School of Technology has been awarded a bronze medal by the International Jury in the group comprising higher education, technical schools, etc., at the Louisiana Purchase Exposition. Its exhibit was warmly commended by the members of the jury, and has been a source of interest to visitors throughout the summer.

—The American Blower Company will supply about 133,000 feet (over 25 miles) of one-inch steam pipe for the "hot-blast" heating and tempering coils to be installed in the new Wanamaker Building in Philadelphia. This pipe is being manufactured into one hundred and eleven "A B C" heater sections, varying in capacity from 3,500 to 56,000 feet of heating surface each. In connection with these heaters and in other parts of the building 28 "A B C" fans will be used, the largest of these having a housing 220 inches high and the smallest 50 inches. The completed apparatus, which is now being constructed in the American Blower Company's factory at Detroit, will make a ten-carload shipment. "A B C" apparatus is also to be installed in the New York Wanamaker Building. Some 44,000 feet of one-inch pipe will be used in the heaters and seven large fans will ventilate the building.

—Alberger condensing apparatus, manufactured by the Alberger Condenser Co., of 95 Liberty St., New York, and exhibited at the Louisiana Purchase Exposition, received a grand prize.

The Eureka Fire Hose Co., of New York, desire to state that Messrs. W. H. Salisbury & Co., who have handled the product of the Eureka Fire Hose Co. for so many years with marked success, will continue to be their only representatives at Chicago,

and it is furthermore hoped will remain indefinitely in control, thus adding to a long term of service that has been characterized by the highest degree of business tact and integrity.

—The Westinghouse Companies at the Louisiana Purchase Exposition have received the following awards from the International Jury: Special award in the Department of Machinery for "the best, most complete and most attractive installation." Twelve grand prizes: To the Westinghouse Electric and Manufacturing Company, for "alternating-current generators and motors, alternating-current turbo-generator installation, static transformers, and rotary converters"—Group 67; to the Westinghouse Electric and Manufacturing Company, for "direct current generators and motors"—Group 67; to the Westinghouse Electric and Manufacturing Company, for "electric railway motors, alternating current and direct, and control systems for single and multiple unit operation and for mining and industrial locomotives"—Group 67; to the Westinghouse Machine Company, for "horizontal gas engines and steam turbines"—Groups 62 and 63; to the Westinghouse Air Brake Company, for "air brakes and friction draft gears"—Group 74; to the Westinghouse Traction Brake Company, for "brakes for electric cars"—Group 74; to the American Brake Company, for "driver brakes"—Group 74; to the Westinghouse Automatic Air and Steam Coupler Company, for "air and steam couplers"—Group 74; to the Westinghouse Brake Company, Limited, London, England, for "air brakes and accessories"—Group 74; to the Westinghouse Company, Limited, of St. Petersburg, Russia, for "air brakes and accessories"—Group 74; to the Union Switch & Signal Company, for "signal systems"—Group 74; to the Cooper-Hewitt Electric Company, for "the development of the mercury vapor arc lamp"—Group 69. Eight gold medals: To the Westinghouse Electric and Manufacturing Company, for "complete switchboards and controlling apparatus, and the application of electric motors for mechanical purposes"—Group 67; to the Westinghouse Electric and Manufacturing Company, for "alternating current, direct current, and Bremer arc lamps and arc lighting systems"—Group 69; to the Westinghouse Electric and Manufacturing Company, for "electric measuring instruments"—Group 71; to the Nernst Lamp Company, for "Nernst lamps"—Group 69; to the Cooper-Hewitt Electric Company, for "vapor lamps for photo-engraving"—Group 15; to the Pittsburg Meter Company, for "water and gas meters"—Group 64; to the Westinghouse Electric and Manufacturing Company, for "industrial betterment work"—Group 138; to the Westinghouse Air Brake Company, for "the housing of the working classes"—Group 136. Four silver medals: To the Westinghouse Electric and Manufacturing Company, for "switches, fuses, and wiring appliances"—Group 69; to the Sawyer-Man Electric Company, for "incandescent lamps"—Group 69; to the Bryant Electric Company, for "electric-light fittings"—Group 69; to the Société Anonyme Westinghouse, Havre, France, for "gasolene automobiles"—Group 72. One bronze medal: To the Perkins Electric Switch Manufacturing Company, for "electric switches"—Group 69.

—H. B. Underwood & Co., of Philadelphia, the manufacturers of portable and other special tools and machines, have issued an attractive souvenir in the shape of a blotter pad with a picturesque celluloid cover.

—The C. W. Hunt Company, of West New Brighton, New York, have been particularly successful at the St. Louis World's Fair, two of their three exhibits securing high awards, the third not entered. The Hunt "Industrial" railway received the gold medal for narrow-gauge railways, and the electric storage-battery locomotive built by this company received the silver medal, being the highest award for this type of locomotive.

—The Ball Engine Co., of Erie, Pa., has received an order for a 1,000-horse-power horizontal cross-compound Corliss engine for the Altoona shops of the Pennsylvania railroad.

—The Goldschmidt Thermit Co., of New York, have been awarded a grand prize at the St. Louis Exposition, where they have had a working exhibit in charge of Mr. W. M. Carr. The Franklin Institute, of Philadelphia, has also distinguished Dr. Goldschmidt for his inventions by conferring on him the Elliott Cresson Medal. As

is well known, this company employs its product, Thermit, consisting of specially prepared granulated or powdered aluminum, for welding rails and many other objects, repairing large broken metal parts, for producing pure iron and iron and steel alloys, and for other purposes.

—The American Cement Company, Pennsylvania Building, 15th and Chestnut Streets, Philadelphia, Pa., have been awarded the first contract for the cement for the Panama Canal, the amount being 10,000 barrels. The bid was made in the name of their New York selling agency, The United Building Material Company, Park Row Building, New York City, and the award was made last Saturday. The American Cement Company have secured for their old reliable "Giant" Portland Cement contracts on some of the most important engineering works in the world, including 1,500,000 barrels for the New York Subway.

—The Moody Publishing Co., of 35 Nassau Street, New York, have published an attractive and interesting little book, entitled "The Art of Wise Investing," which contains a series of short articles on investment values, pointing out the essential characteristics of safe investment securities, with a review of the financial pitfalls into which superficial examination inevitably leads.

—Allis-Chalmers Company has won high honors at the St. Louis Exhibition with each of their three exhibits:—steam engine, electrical, and mining. The five-thousand-horse-power engine popularly known as the "Big Reliable," and the huge generator built by this company's electrical department, otherwise known as the Bullock Electric Manufacturing Company, each won a grand prize. These two machines, forming the huge unit which supplies the world-famous decorative lighting of the Exposition buildings and grounds, and which have never failed under the most frequent and most unexpected emergency loads, are so well known that it is unnecessary to describe them again. In the Department of Mines and Metallurgy the Allis-Chalmers exhibit was also awarded a grand prize, the highest honor given by the International Jurors. Among other features of this mining exhibit and contributing to the success which won the highest award, are the famous style "K" Gates gyratory rock and ore breakers, the Overstrom concentrating table, the Allis-Chalmers style "A" and "B" crushing rolls, the Gates ball and tube mills, and the heavy six-foot Huntington mill, known as the "Anaconda" type, manufactured only by this company. The Bullock Electric Mfg. Company's grand prize also covered all their alternators, synchronous motors, direct-current generators and motors, and rotary converters. This award, in competition with their older and greater competitors, is a significant tribute which must interest all users of electrical machinery. In addition to all this, the Bullock system of multiple-voltage control of motors won a gold medal.

—Morse chains, made by the Morse Chain Co., of Trumansburg, N. Y., have been installed in the Vulcanized Rubber Company's works at Morrisville, Pa., for transmitting power from the engine to lines of shafting, and from about forty electric motors to individual tools, blowers and pumps. In a statement by Mr. George Hill, consulting engineer, of New York, who installed this plant, he describes the exacting requirements, speaks of the successful operation of the Morse chains in driving the shafting from the engine, and the saving in space due to their use, and in conclusion says: "The cost of the individual drives from the motor was much more than for leather belting, but the Morse chain has a most decided advantage on account of the positive speed ratio obtained, less space required, higher efficiency and greater durability, making it the more desirable transmission to use. Loss of time repairing belts is a considerable item each year, that costs in the delivery of an order frequently far more than the chains cost. The efficiency claimed by the makers was practically 99 per cent., and on the large speed ratios used I could hardly expect to obtain an efficiency of over 94 per cent. by the use of belting. This difference in efficiency between the two methods of transmission would, if the chain were as durable as claimed, save enough in the power cost alone to renew the chain when worn out. While not enough time has elapsed to substantiate all the claims made by the makers, careful inspection of the chains running

show them to be giving perfect service, and this has persuaded me to use the Morse chain for other contracts, as commercially they are the cheapest to use if a period of five or more years is considered."

—The Laidlaw-Dunn-Gordon Company, of Cincinnati, who installed the two large air compressors located in Block 33 of Machinery Building, have been awarded a grand prize by the Louisiana Purchase Exposition for their improvements in valve mechanism. One of the machines has a capacity of 1,300 cubic feet of free air per minute when running at 125 revolutions, and is used to supply the general compressed-air requirements of the Exposition, while the other is capable of furnishing 530 cubic feet and supplies the transportation exhibits. The large machine is fitted with an improved type of valve gear, the distinguishing feature of which is the novel manner of using poppet valves for controlling the opening of the discharge in combination with the semi-rotary, mechanically moved valves for controlling the closing of the discharge and the opening and closing of the suction.

—The Electric Controller and Supply Company, of Cleveland, O., have been awarded a gold medal for their St. Louis World's Fair exhibit. The apparatus shown consists of a full line of their regular controllers for crane, charging machine and similar service; a working exhibit of a magnetic switch controller built for motors of any horse power; magnetic friction and stop brakes; cushion-type solenoids; electric lifting magnets for plates, billets, etc.; resistance banks; knife switches; and a working exhibit of their direct-connected variable-speed motor drive for planers.

—The Eureka Fire Hose Co., of New York, announce that their "Eureka," "Paragon" and "Red Cross' brands of seamless rubber-lined fire hose have been awarded a gold medal at the St. Louis World's Fair. It was to be expected that the product of the Eureka Fire Hose Co. would receive such substantial compliment, as their fire hose is a recognized necessity in every fire department where reliability is considered paramount to every other consideration.

—The Walworth Manufacturing Co., of Boston, have been awarded a gold medal at the St. Louis Exposition for their exhibit of valves, brass and iron goods, pipe fittings, and engineers', gas and steam fitters' tools.

The Derry-Collard Company, of 256-257 Broadway, New York, have published a "Tractive Power Chart" for finding the drawbar pull of locomotives without making any calculation. This chart is printed on a sheet of tough paper about 15 by 20 inches in size. It gives the cylinder diameter, area and volume for all diameters between 15 and 34 inches, and strokes between 20 and 36 inches, and includes boiler pressures between 120 and 230 pounds, and driving-wheel diameters from 28 to 90 inches. It not only shows the drawbar pull when these data are given, but it can be worked backwards to determine what sized engine must be used to get a certain drawbar pull. This chart will be found very useful, and can be obtained by sending 50 cents to the publishers.

—The Jury of Awards of the Louisiana Purchase Exposition has awarded a gold medal for rail fastenings to the Continuous Rail Joint Company of America, for their display made in the Transportation Building. The exhibit shows various types of rail joints produced by patented machinery controlled by the company in this country. The careful manufacture and perfect fit, giving three points of contact in one piece of metal, thus forming a rail joint of two symmetrical pieces, obtained as a result of these patents, have secured for them both from steam and electric railroads an appreciation which is shown by the fact that over 20,000 miles of railroad track have been equipped with the continuous rail joint during the past ten years. The company owns and operates the Albany Iron & Steel Works at Troy, N. Y. They have on the market to-day types of joints for tee rails and girder rails that are made of rolled steel. They also manufacture step, or compromise joints, to connect rails of different sections, and obtain a perfect surface and gauge for abutting rails. These are made of cast steel. This company is now bringing out a new type of insulated rail joint, and also an electric bonding joint to be placed upon the market. These appliances have already been introduced in many foreign countries. The general offices of the company have always been at Newark, N. J.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Compressors.

Catalogue No. 53, entitled "Modern Practice in Air Compression," containing descriptions of Sullivan air compressors, and a great deal of useful and interesting information regarding compressed air and its various applications, with many handsome illustrations and an index. 9 by 6 in.; pp. 127. Sullivan Machinery Co., Railway Exchange, Chicago.

Alternators.

Bulletin No. 3, containing illustrations and descriptions of alternating-current generators direct connected to De Laval steam turbines by means of flexible couplings, with tables of dimensions. 9 by 6 in.; pp. 24. De Laval Steam Turbine Co., Trenton, N. J.

Carriers.

Pamphlet entitled "Mechanical Messengers," containing half-tone illustrations and descriptions of Lamson pick-up and delivery carriers, which afford an automatic and rapid means of transporting messages, packages, books, and other articles in offices, stores, factories, libraries and other establishments. 11¾ by 9 in.; pp. 16. Lamson Consolidated Store Service Company, Boston, Mass.

Cement Sidewalk.

Pamphlet entitled "Suggestions as to the Method of Construction of Cement Sidewalk Paving," compiled by Albert Moyer, and containing specifications for "granolithic cement concrete" or "artificial stone" sidewalks and pavements, with some typical views. 9 by 6 in.; pp. 12. Vulcanite Portland Cement Co., Flatiron Building, New York.

Centrifugal Pumps.

Pamphlet devoted to high-grade centrifugal pumping machinery, with illustrations of a few representative designs, a glossary of terms and other useful data and tables. 11 by 8½ in.; pp. 16. R. D. Wood & Co., Philadelphia.

Chains.

Catalogue No. 185, entitled "Forgings and Castings," containing illustrations and descriptions of the "Warwick" and the "Trident" chains for snips' cables, dredges, steam shovels, conveyors, loading, mining, quarrying, rafting and other uses, and also shackles, swivels, rafting dogs, bolts, davits, cleats and other appliances for marine, towing and conveying work. 9 by 6 in.; pp. 32. Newhall Chain Forge & Iron Co., 9-15 Murray St., New York.

Channeler.

Form 322, a pamphlet with illustrations and descriptions of the "Broncho" channeler, a light, handy machine for cutting channels in rock, and for doing other work in quarries and rock excavations. 9 by 6 in.; pp. 15. The Ingersoll-Sergeant Drill Co., 26 Cortlandt St., New York.

Chimneys.

Pamphlet, containing illustrations and descriptions of the Weber system of constructing chimneys of concrete, reinforced by vertical T steel bars, encircled by steel rings, and connected by sheet-iron clamps, together with views of some large completed chimneys. 9 by 4 in.; pp. 31. Weber Steel-Concrete Chimney Co., Ashland Block, Chicago.

Condensers.

Catalogue No. 4, containing half-tone illustrations and descriptions of Alberger barometric condensers and their auxiliary apparatus, central condensers, single and two-stage dry vacuum pumps, Corliss circulating pumps, centrifugal circulating pumps, series-multiple centrifugal pumps, cooling towers, exhaust relief valves and entrainers, and other high-grade condensing apparatus. 9 by 6 in.; pp. 48. Alberger Condenser Company, 95 Liberty St., New York.

Cooling Towers.

Pamphlet, containing illustrations and descriptions of Stocker's patent cooling towers for cooling the water from condensers in steam plants, ice factories and other plants, with an interesting account of the advantages and economy of cooling towers. 8½ by 6 in.; pp. 36. George J. Stocker, St. Louis.

Coupling.

Circular, containing illustrations and description of the Almond patent coupling, a countershaft for transmitting motion at right angles in a noiseless and very efficient manner. 12 by 9 in.; pp. 4. Also, circulars and folders devoted to the Almond turret-head tool drill chucks, flexible steel tube for conveying oil or gas, and for electric and gas brackets, and other specialties. T. R. Almond Manufacturing Co., 83 and 85 Washington St., Brooklyn, N. Y.

Dry Kilns.

Illustrated sectional catalogue No. 166, devoted to the "A B C" dry kilns for timber products. It contains descriptions of moist air dry kilns, blower dry kilns, hot blast apparatus and all kinds of dry kiln appurtenances, with remarks on the theory of kiln lumber drying, and views of kiln plants in various parts of the world. 8¾ by 7 in.; pp. 78. American Blower Co., Detroit.

Electric Apparatus.

Binder containing many bulletins devoted to arc lamps, electric generators, electric motors, motor-starting rheostats, wattmeters, voltmeters, ammeters, switchboards, cut-outs, transformers, street-lighting systems, and other electric machinery and apparatus, with many illustrations. Also, index to bulletins. 10½ by 8 in. Fort Wayne Electric Works, Fort Wayne, Ind.

Electric Driving.

Bulletin No. 221, devoted to "Direct-Current Motor Equipments for Printing Presses and Allied Machines," and containing descriptions and many illustrations of electric motors, controllers, resistances, and other apparatus and their application to machinery in printing, engraving and stereotyping plants. 10½ by 8 in.; pp. 48. Sprague Electric Company, 527-531 W. 34th St., New York.

Electric Switches.

Bulletin No. 6010, devoted to "Knife Switches." It contains illustrations, descriptions, prices, tables of dimensions and other data concerning various types and sizes of knife switches and other electric switchboard apparatus and fixtures. 10¾ by 7¾ in.; pp. 38. Western Electric Company, 259 South Clinton St., Chicago.

Elevator Machinery.

Catalogue D, devoted to elevator machinery and power transmission appliances. It contains illustrations, descriptions and price lists of pulleys, sheaves, hand wheels, tension carriages, gears, couplings, hanger, belt tighteners, rollers, sprocket wheels, and many other appliances for elevating and conveying work and for shafting and belting. Also, index. 7½ by 5½ in.; pp. 212. Minneapolis Steel and Machinery Co., Minneapolis.

Feed-Pump Controller.

Pamphlet, with illustrated description and price list of Mullin's automatic controller for boiler feed pumps, and directions for connecting and operating it. 9 by 6 in.; pp. 4. Also, pamphlet devoted to Mullin's duplex-automatic regulator and mixer for fuel oil. 9 by 6 in.; pp. 4. The Federal Valve Co., Seattle, Wash.

Gauges.

Catalogue for 1904, containing illustrations, descriptions and prices of high-grade pressure and vacuum gauges of the self-contained type for all purposes, marine clocks, tachometers, watchman's portable control watches, steam-engine indicators, testing pumps, mercury gauges and thermometers, water gauges, safety valves, and many other fittings and appliances. 10 by 6½ in.; pp. 106. Standard Gauge Mfg. Co., Syracuse, N. Y.

Graphite.

Pamphlet giving the important facts, together with the prices, of Dixon's lubricating graphites and graphite lubricants, with illustrations and an ornamental cover. 8½ by 5½ in.; pp. 28. Also, illustrated pamphlet, showing the benefits derived from the use of graphite for lubrication on automobiles and motor boats. 7¾ by 5¼ in.; pp. 21. Joseph Dixon Crucible Co., Jersey City, N. J.

Lava.

Pamphlet entitled "Lava for Mechanical and Electrical Purposes," containing illustrations and descriptions of gas tips and burners, electrical insulators and other objects made of the mineral talc, which is machined in its natural condition and then baked at a high temperature to a condition of extreme hardness. 9 by 6 in.; pp. 12. American Lava Company, Chattanooga, Tenn.

Magnetic Switches.

Bulletin No. 1010, with descriptions and illustrations of magnetically operated switches for electric circuits, of the gravity type and the clapper type; and Bulletin No. 1004, devoted to solenoids and electromagnets of the "magnetic-cushion" type, in which there is no blow or shock when the plunger is brought to rest at the end of its travel. 6¾ by 5 in.; pp. 8. The Electric Controller and Supply Co., Cleveland, O.

Power Station.

Handsome pamphlet, entitled "The Power of the New York Subway," with ornamental cover and half-tone illustrations, devoted particularly to the large Allis-Chalmers steam engines in the great power station of the Interborough Rapid Transit Company, and with a general description of the Subway itself. 10¼ by 8 in.; pp. 19. Allis-Chalmers Company, Milwaukee.

Producer Gas.

Catalogue A, section 1, dealing with producer gas for power and fuel, its uses and cost, and containing illustrations of gas producers, a general discussion of producer gas, and comparison of producer gas with other sources of power. 9 by 6 in.; pp. 15. Wile Power Gas Co., Rochester, N. Y.

Pumps.

Illustrated pamphlet, containing descriptions of some of the characteristic Cameron designs of steam pumps, including sinking pumps, feed pumps and other regular and special types, with tables of prices, dimensions and weights. 5¾ by 3¼ in.; pp. 52. A. S. Cameron Steam Pump Works, Foot of East 23d St., New York.

Steam Head.

Bulletin L-602, illustrating and describing a special steam head for operating deep-well pumps, where it is necessary to place the pump cylinder far below the steam cylinder. 9 by 6 in.; pp. 4. Laidlaw-Dunn-Gordon Co., 114-118 Liberty St., New York.

Steam Shovels.

Catalogue No. 4, containing half-tone illustrations, descriptions and tables of principal dimensions of steam shovels and excavators for mines, smelters, blast furnaces, ore docks, brickyards, cement works, railroads and contractors. Shovels equipped with electric motors are shown, and dipper dredges also are illustrated. 6 by 9 in.; pp. 32. The Thew Automatic Shovel Co., Lorain, O.

Well Machinery.

Manufacturers' catalogue, illustrating and describing a full line of well sinking and prospecting machinery, artesian-well and compressed-air pumping machinery, air compressors, gasoline and steam engines, boilers and many tools and appliances for well sinking by the most modern methods, with code words and prices. 9 by 6 in.; pp. 160. The American Well Works, Aurora, Ill.

NEWS SUPPLEMENT

The Engineering Magazine—February, 1905

Personal.

—J. U. Jones, of Dallas, Texas, has joined the staff of the Allis-Chalmers Co., Milwaukee, and will hereafter represent them in Texas and its tributary territory.

—W. L. Loveland has been appointed manager and H. Schifflin assistant manager of the mining and crushing department of the Allis-Chalmers Co., with headquarters in the New York Life Building, Chicago.

—C. W. Whitney has resigned as Pacific Coast representative of the McGraw Publishing Co., New York, and has taken charge of the publicity department of Abner Doble Co., San Francisco, engineers and manufacturers of tangential water wheels and needle regulating nozzles.

—Henry C. Mortimer, Jr., of the General Electric Inspection Co., has joined the New York office staff of the Crocker-Wheeler Co. He will assist F. B. DeGress, manager of that office, and will succeed A. J. Thompson, who has accepted a position with the New York branch of the Bullock Electric Manufacturing Co.

—Henry S. Manning has sold to Charles A. Moore his entire interest in the firm of Manning, Maxwell & Moore, together with his interest in the Ashcroft Mfg. Co., Consolidated Safety Valve Co., Hayden & Derby Mfg. Co., and Hancock Inspirator Co. There will be no change in the name or character of the firm and its business in the future will be conducted by Mr. Moore and the men who have been associated with him.

—W. S. Montgomery, for many years sales manager for the Conover Condenser Co., and for the past year New York manager for the Payne Engine Co., has formed a partnership with G. M. Rogers under the firm name of Rogers & Montgomery, with offices at 147 West 23rd St., New York. The new firm will deal in a general line of small labor-saving tools, and are the exclusive United States sales agents for the new line of hand and press punches lately brought out by the Gem Tool Works of Brooklyn.

Industrial Notes.

—The annual meeting of the American Institute of Mining Engineers will be held Feb. 21, at 99 John St., New York.

—The Electric Controller & Supply Co., Cleveland, has placed George Magalhaes in charge of its eastern office at 136 Liberty St., New York.

—The Bristol Co., Waterbury, Conn., was awarded a gold medal for an exhibit of recording instruments at the St. Louis World's Fair.

—Chicago Pneumatic Tool Co., Chicago, has received a cablegram from their London branch for 705 tools. This is an indication that their business abroad is growing.

—On account of the rapid growth of its business, the Pittsburg Gage & Supply Co., Pittsburg, Pa., has leased another store and warehouse adjoining their present location. The building is four stories, 50 x 200 feet.

—Goldschmidt Thermit Co., New York, at the request of the United States authorities, has presented to the National Museum at Washington, its entire exhibit at the World's Fair, St. Louis.

—The F. W. Braun Co., Los Angeles, Cal., was awarded gold medals by the World's Fair, covering practically their entire line of apparatus and appliances for assayers, metallurgists and chemists.

—Missouri Pacific Railway runs a train between St. Louis and the City of Mexico that saves over nineteen hours. It leaves St. Louis every day at 2:21 P. M. and arrives at the City of Mexico at 10.50 A. M. the third morning.

—Brown Hoisting Machinery Co., Cleveland, has issued a set of illustrated cards, printed in colors, describing in simple language, for the non-technical, sixteen important types of cranes manufactured by them.

—Brown Corliss Engine Co., Corliss, Wis., has received the contract from the city of Milwaukee to furnish and erect complete, at the North Point pumping station, one triple expansion high duty crank and fly wheel 20,000,000-gallon pumping engine.

—The engraving and steel stamp business of the Schwerdtle Stamp Co., and the rubber stamp business of the Bridgeport Stamp Co., have been consolidated, and will hereafter be known as the Schwerdtle Stamp Co., with offices at Bridgeport, Conn.

—Diamond Drill & Machine Co., Birdsboro, Pa., has opened a New York office at 52 Broadway. Their steel and iron foundries are busier now than at any time during the past year, while their machine shop is running double, being especially busy on rolling mill and blast furnace work.

—The National Electric Co., Milwaukee, was awarded the contract for equipping with air brakes the new convertible type of cars of the Cleveland electric railway. This is the largest contract for individual air brake compressors that has ever been placed in this country.

—Isthmian Canal Commission, Washington, are inviting proposals for machine tools, machinery, hand cars, leather belting, rope, canvas and rubber hose, cars, and miscellaneous supplies, including coal tar, axle grease, glue, ticking, horse hair, etc. Copies of the proposals may be had upon application to the commission.

—Brown Corliss Engine Co., Corliss, Wis., has received an order from the Illinois Steel Co., for a 2,000 horse power combined vertical and horizontal Corliss engine to be established at their Joliet plant. This engine is similar in design to the engine exhibited at the World's Fair by Allis-Chalmers Co.

—The Illinois Steel Co., Joliet, Ill., is about to begin an extension of its works, at a cost of $100,000, to accommodate the business of the Continuous Rail Joint Co., of America, Newark, N. J. The latter company has extensive works at Troy, N. Y., but its western business requires a plant nearer the center of trade.

—The California Gas & Electric Corporation, San Francisco, has just ordered from the Stanley Mfg. Co., two frequency changing outfits of 5,000-kilowatt capacity each, amounting to virtually 20,000-kilowatt capacity divided between four machines operated as two motor generator sets. The contract also includes transformers of 1,000 kilowatts.

—The Erie Railroad, through its Industrial Department, has issued a map of its system, which shows, in graphic style, the many admirable locations for manufacturing, mining and other industries along its line. Full particulars regarding this department of the Erie Railroad may be obtained from its Industrial Commissioner, Mr. Luis Jackson, 21 Cortlandt St., New York.

—The Electric Controller & Supply Co., Cleveland, has just shipped the second of two 200 horse power 220-volt type M. T. magnetic switch controllers to the Lorain plant of the National Tube Co. They are for the control of the reversing motors driving the tilting tables on each side of the plate mill. Other shipments of controllers of this type have been made recently to the Carnegie Steel Co., the Lackawanna Steel Co., and the Illinois Steel Co.

—The Allis-Chalmers Co. opened new sales offices in Philadelphia on January 1st in the Land Title Building. The offices heretofore maintained by the electrical department of the company, the Bullock Electric Mfg. Co., in the North American Building, have also been removed to the Land Title Building, where they have been consolidated with those of the parent company. The new offices are in charge of W. A. Wood.

—The following concerns are among those who have recently equipped their power plants with the White Star continuous oiling system installed by the Pittsburg Gage & Supply Co., Pittsburg: Portland Electric Light Co., Portland, Ore.; Peoples Power Co., Moline, Ill.; Watson, Jack & Co., Montreal, Can.; Diebold Safe & Lock Co., Canton, O.; Robb Engineering Co., Amherst, N. S.; and Suffolk Light & Ice Co., Suffolk, Va.

—The Westinghouse Electric Manufacturing Company's "Diary" for 1905 is lifted into a class quite above that of most publications of the kind by the fact that in addition to the general tables of useful data, equivalents, and formulæ, it contains a special section of "Engineering Data for Electrical and Mechanical Engineers." These cover the subjects of electric railways, motors for machine-tool drive, illumination, power transmission, lightning arresters and choke coils, operating hints on electrical machinery, first aid to the injured, steam boilers and heating value of coal,

commercial power gases, and the performance of gas engines and steam turbines. The convenient and compact presentation of the material make the diary a serviceable pocket reference book.

—The Wellman-Seaver-Morgan Co., Cleveland, was recently awarded contract to construct two large coal handling machines for the Boston Coal Dock & Wharf Co., Duluth, Minn. This is one of the docks under the management of the St. Paul & Western Coal Co. The machines consist of two conveyor bridges, each about 350 feet long, including front and rear cantilevers, and are designed so that coal may be screened and loaded into box cars as well as unloaded from vessels, built to be operated by steam. They will be equipped with 2-ton Hulett excavating buckets, and machinery designed to give maximum speeds of operation. The structural work will be of steel throughout, and the machines will be self-propelling along the dock.

—The Shepherd Engineering Co., Franklin, Pa., report recent installations of their engines as follows: Eberhard Faber Pencil Co., Brooklyn, one 600 horse power, four valve, cross compound engine; two 250 horse power, each direct connected to two generators installed in the Russia Building, Boston; one engine direct connected to Crocker-Wheeler generator, at Fort Andrews, Boston Harbor; two engines for Brandon Hall, Beacon Hill, Boston; three engines for the new office building, Columbus Savings & Trust Co., Columbus, Ohio; two engines to the Arbuckle-Ryan Co., Toledo, Ohio, for installation at the plant of the Northwestern Ohio Bottle Co.; and one engine to the Joyce-Cridland Co., Dayton, Ohio. They have also been awarded the gold medal for their engines at the St. Louis World's Fair.

—Westinghouse Electric & Manufacturing Co., Pittsburg, has closed the following contracts: International Paper Co., Berlin, N. H., one 250-kilowatt alternating current generator of the revolving armature type, and three 40 horse power alternating current motors, with switchboard, transformers etc.; Detroit United Railway Co., Detroit,, one 1,500-kilowatt railway generator and a 250-kilowatt booster set. Other street railway contracts just closed include 50 four-motor car equipments, to be used by the Cleveland Electric Railway Co., Cleveland. Syracuse Railroad Construction Co., two 1,500-kilowatt turbo-generator outfits which will generate current at 3,300 volts, 3-phase and 25 cycles. Each turbo-generator will be furnished with a 50-kilowatt exciter mounted on the turbine shaft, two 500-kilowatt rotary converters and six 400-kilowatt rotary converters; twenty-four transformers, with a total capacity of 6,500 kilowatts, a 13-panel switchboard for the main generating station, and three sub-station switchboards of five panels each. Motor equipments included in the contract call for twelve quadruple equipments of Westinghouse 110 horse power motors, as well as eight quadruple and two double equipments of motors of other sizes; Ontario Power Co., for an alternating current generator with a rated output of 10,000 horse power at 85 per cent. power factor. This is in addition to three other machines of similar type for use in furnishing this plant. The generators are of the revolving-field, two-bearing type, designed for direct connection to water-wheels; they generate 3-phase current at 12,000 volts and 25 cycles, and run at a speed of 187½ revolutions per minute. Among other apparatus included in the contracts are twelve 30,000-kilowatt oil-insulated water-cooled transformers, wound for 12,000 and 60,000 volts; two 375-kilowatt exciters, and complete switchboards. They have received through Takata & Co., Tokio, their Japanese agents, contracts for 13 direct current generators, each of 52.5 kilowatts capacity and 13 spare armatures. Each generator will be driven by a 125 horse power steam engine, and the 13 engines will be supplied by the Westinghouse Machine Co. Turbo-generator contracts closed include two 1,000-kilowatt outfits for the Haverhill (Mass.) Electric Co., to be used in lighting and power work; two 1,500-kilowatt outfits for the Rochester, Syracuse and Eastern Railroad, and one 1,000-kilowatt outfit with exciter for the Springfield (Mass.) Electric Light Co.; also a 300-kilowatt turbo-generator with exciter for the Northern Electric & Manufacturing Co., Montreal. The Springfield Electric Light Co.'s contract also included two 500-kilowatt rotary converters and four 300-kilowatt transformers.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Compressors.

Catalogue No. 35 consisting of advance sheets of Catalogue No. 36, and includes some information additional to that appearing in the first edition of No. 35. There are views of several important new installations, including those of the Cleveland Stone Co., and at the Mare Island Navy Yard. Air receivers, inter- and after-coolers are also given a place. The complete catalogue No. 36 will appear later. 7 by 10 in.; pp. 100. Ingersoll-Sergeant Drill Co., 26 Cortlandt St., New York.

Pamphlet, illustrating and describing an extensive line of air compressors and vacuum pumps. More than twenty-one types of machines are shown. The range of sizes includes machines displacing from two cubic feet of free air per minute to those having a capacity of 1400 cubic feet. 6 by 9 in.; pp. 48. Clayton Air Compressor Works, New York.

Leaflet, containing description and illustrations of air compressors. 4¼ by 8¼ in.; pp. 6. Norwalk Iron Works Co., So. Norwalk, Conn.

Centrifugal Pumping.

A reprint of the paper by Professors J. E. Denton and William Kent, giving full details of the notable tests recently made by them of the De Laval Centrifugal pumps. The efficiencies obtained in these tests are said to rank above any ever before authentically recorded; and the high authority of the engineers in charge makes the pamphlet a very valuable one. Fully illustrated. 24 pp.; 6 by 9 in. De Laval Steam Turbine Company, Trenton, N. J., U. S. A.

Centrifugal Pumps.

Catalogue A 1, devoted to high-grade improved centrifugal pumping machinery, with illustrations of different types, tables showing sizes, capacity, horse power, weight and prices. 3¾ by 6 in.; pp. 30. Lawrence Pump & Engine Co., Lawrence, Mass.

Dry Steam.

A 60-p. pamphlet, 6 by 9 in., specifically designed to emphasize the necessity for employing dry steam in order to obtain the maximum of economy, efficiency and safety; together with an exposition of the various methods employed, and maintaining the superiority of the system of "mechanical" separation, as demonstrated in the Stratton Separator. The Goubert Manufacturing Company, 85 Liberty Street, New York, U. S. A.

Electric Hoists.

The Sprague Electric Co., 527 West 34th Street, New York, have issued a beautifully illustrated pamphlet, 9 x 12 inches, presenting numerous diagrams and detailed photographic views of the now celebrated Sprague Electric Hoists. A fine specimen of the modern printing art as applied to the practical needs of the Engineer, the Superintendent, and the Manager.

Lamps.

Pamphlet, describing street lighting by Nernst lamps in Berwyn, Ill. 3½ by 6¼ in.; pp. 12. Nernst Lamp Co., Pittsburg.

Mine Fans.

A 12-page pamphlet, 6 by 9 in., illustrating and describing the "Stine" fans, which, since 1895, have been so widely introduced throughout the mining regions of the United States. Authentic details as to the actual performances of the fans are given, together with a list of those who have adopted them. S. B. Stine & Son, Osceola Mills, Pa., U. S. A.

Mining Machinery.

Catalogue for 1905, profuse in its illustrations of the mining machinery handled (especially of crushers and hoisting and winding engines), together with many valuable tabular exhibits indicating dimensions, capacity, etc., etc. 8 by 10 in.; pp. 140. Earl C. Bacon, Engineer, Havemeyer Building, New York, U. S. A.

Mond Gas.

An admirable publication, 106 pp.; 8 by 10 in., fully describing the origin, processes, and machinery of this modern source of power for gas producer plants. The wide range of applications is remarkable, and the publication is one which every up-to-date engineer, superintendent and manager should have at hand for reference. R. D. Wood & Co., Philadelphia, Pa., U. S. A.

Rock Drills.

Rock Drills and Drill Mountings is the title of an admirable pamphlet of 80 pages, issued by The Rand Drill Co., 128 Broadway, New York. It opens with an authentic history of the development of the rock drill by the late Addison C. Rand, followed by numerous and beautiful illustrations of modern drills now in use for all purposes, together with tabular exhibits clearly indicating the performances of all the various types of drills in some of the most important mining and tunneling work done in recent years. A pamphlet which every engineer should have at hand for reference purposes.

Steam Pumps.

Catalogue for 1905, illustrating and describing in detail a great variety of pumps for different service made by this firm. Few modern catalogues that come to us for notice present so much valuable information in detailed and accurate form as this one. It is a model in size, convenience of arrangement, orderly presentation of valuable information beautiful illustrations, and intelligent introductory matter, indicating to purchasers all the facilities of the firm in meeting their exact requirements. 6 by 9 in.; pp. 150. A. S. Cameron Steam Pump Works, New York, U. S. A.

NEWS SUPPLEMENT

The Engineering Magazine—March, 1905

Personal.

—William Sellers, founder of William Sellers & Co., Inc., Philadelphia, died last month at the University Hospital, Phila.

—Edward H. Mullin, manager of the Publicity Department of the General Electric Co., died suddenly at his home in Milburn, N. J.

—E. L. Byron, who for the past twenty years has been connected with the Vulcan Iron Works Co., has been advanced to the position of general manager. Alexander Backus will not retire from that place, but Mr. Byron will take much of the responsibility that has hitherto rested on the shoulders of Mr. Backus.

—Warwick H. Payne, who has for a number of years been connected with the Eureka Fire Hose Co., New York, as manager of their southern department, has been placed in exclusive charge of the States of North and South Carolina and Virginia, with headquarters at 704 Century Bldg., Atlanta, Ga.

Industrial Notes.

—A. L. Ide & Sons, Springfield, Ill., has opened a New York office at 11 Broadway. J. G. Robertson will be the manager.

—Hess-Bright Mfg. Co., Philadelphia, the manufacturers of ball bearings, has recently removed its offices to 245-47 No. Broad St.

—R. D. Nuttall Co., Pittsburg, has appointed the Chas. W. Wood Electric Co., 246 Summer St., Boston, their agent for the sale of Nuttall material in the New England States.

—Falkenau-Sinclair Machine Co., Philadelphia, who are retiring from business, offer for sale a fine modern machine manufacturing plant, with business ready for operation.

—Morse, Williams & Co., Philadelphia, with branch offices in Boston, New York, Baltimore, and Atlanta, have opened an office at 1018 Penn Ave., Pittsburg, for the sale and erection of all classes of freight and passenger elevators.

—Hanna Engineering Works, Chicago, manufacturers of pneumatic tools, has made arrangements with the Thos. W. Pangborn Co., 42 Dey St., New York, and Edward J. Etting, Harrison Bldg., Philadelphia, to act as their exclusive agents for the territories in which they are located.

—The A. S. Cameron Steam Pump Works, New York, report the sale of three more of their horizontal piston pumps to the O'Rourke Construction and Engineering Co., New York, contractors for the improvement in the Pennsylvania R. R. tunnel.

—The University of Tennessee, Knoxville, Tenn., has purchased from the A. S. Cameron Steam Pump Works, New York, through McClung & Co., their agents in Knoxville, a Cameron regular boiler feed pump as a part of the laboratory equipment in the mechanical engineering department for the use of students in laboratory tests.

—The Ingersoll-Sergeant Drill Co., New York, has sold to the American Car & Foundry Co., its entire pneumatic equipment including air compressors and Haeseler hammers and drills for use in equipping its new English shops where the steel cars for the London Underground Railway are to be built.

—Broderick & Bascom Rope Co., St. Louis, received five highest awards, all told, on their exhibit of wire rope and haulage systems at St. Louis. Two of these were Grand Prizes on wire rope, one being in the Mines and Metallurgy Building, and the other, in the Manufacturers' Building; and a third was a Grand Prize for underground wire rope haulage.

—The annual convention of officers and branch managers of Crocker-Wheeler Co. took place at the main office and works, Ampere, N. J., January 26, 27 and 28. Managers and representatives were in attendance from all parts of the country. On the evening of the 27th a banquet was held at the Café Martin in New York, at which the president of the company, Dr. Schuyler Skaats Wheeler, presided.

—The Allis-Chalmers Co., Chicago, has consolidated their officers with those of the Bullock Electric Mfg. Co., in the following cities: St. Louis, Chemical Bldg., H. P. Hill, manager; Cleveland, New England Bldg., Franklin Wharton, manager; Pittsburg, Frick Bldg., H. Wiederman, manager; Kansas City, Dwight Bldg., George W. Mattison, manager; and Buffalo, Ellicott Square Bldg., George W. Pulver, manager.

—Marine Iron Works, Chicago, are building a new steamer for quick passenger service on northern Lake Michigan. She will have a steel hull, 142 feet long by 28 feet beam, and will draw, with ordinary load, 11 feet. The engine cylinder diameters will be 14 and 22 and 36 inches by 24 inch stroke, fitted with steam reverse. They have also been awarded the contract for building the fore and aft compound condensing machinery for the new Government survey boat for use on the coast of the Gulf of Mexico.

—Loew Supply & Mfg. Co., Cleveland, has recently engaged in the manufacture of steam specialties and have received the following orders: Doan-Jones Lumber Co., Elmira, N. Y., 150-horse power combination feed water heater grease and oil separator; Kitson Machine Co., Lowell, Mass., 150-horse power combination feed water grease and oil separator; Lion Brewery, New York, one 6-inch oil separator, 1,000-horse power combination feed water grease and oil separator; Trenton Hygie Ice Co., Trenton, N. J., 12-inch Loew grease and oil Separator; Citizens Water Supply Co., Newton, Elmhurst, N. Y., 250-horse power combination feed water heater grease and oil separator.

—The new type of magnet for handling pig iron, small billets, scrap iron or steel, small steel or iron castings, bolts, rivets, etc., in bulk, recently put on the market by the Electric Controller & Supply Co., Cleveland, is the result of long experience and persistent experimenting to get the most efficient design. It is adapted to carry on the hook of a crane and can be controlled by the crane man, who can thus perform the entire operation of loading or unloading a car or loading melting stock into charging boxes with no ground men or helpers. This type of magnet has so obviously supplied the demand for a means of materially reducing the cost of handling such raw materials that the company is experiencing a heavy call for it.

—The Pelton Water Wheel Co., San Francisco, report several recent sales as follows: One 700-horse power Pelton wheel for the hydraulic plant of the Grande Ronde Electric Co., Oregon; one 450-horse power Pelton wheel for the Nanaimo Electric Light and Heating Co., British Columbia; one 600-horse power Pelton wheel to be direct coupled to a 400-horse power Allis engine for the Silver Lake Mines, Colorado; one 450-horse power Pelton wheel unit is also under course of construction for the Territorial government of Hawaii and a 900-horse power unit for the La Grande Water Storage Co., Oregon. Pelton combination needle and deflecting nozzles are used, the deflecting portions being handled by Sturgess and Lombard governors.

—The Westinghouse Electric & Mfg. Co., Pittsburg, has just closed a contract for the electrical equipment of the cotton mill of the Dwight Mfg. Co., Chicopee, Mass. The contract provides for the following apparatus: one 440-volt, A. C. generator, 900-kilowatt rated capacity to supply three-phase current at a frequency of 60 cycles. This generator is to be direct connected to a C. & G. Cooper 26 and 52-inch by 48-inch stroke cross compounding condensing; one 25-kilowatt excited direct connected to Westinghouse engine, and one 22½-kilowatt motor driven exciter. There will also be provided a four panel switchboard to control generator, exciters and six feeds. The electric power plant is to be placed in a new building to be built as an addition to one of the present engine houses; in this way putting the two engines under the supervision of one engineer. To utilize the current produced by this plant the following Westinghouse type C motors wound for 60 cycles, three-phase, will be located in the various parts of the mill: Two 200-horse-power 580 R. P. M.; six 100-horse power, 580 R. P. M.; three 75-horse power, 690 R. P. M.; three 50-horse power, 850 R. P. M.; and two 40-horse power, 850 R. P. M.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Chucks.

Catalogue, containing illustrations, descriptions and prices of lathe and drill chucks. 6 by 9 in.; pp. 32. Westcott Chuck Co., Oneida, N. Y.

Converters.

Bulletin No. 1031, treats of rotary converters. Contains illustrations of several converters installed at the So. Chicago Railway Co.'s plant. 6 by 9 in.; pp. 12. Bullock Elec. Mfg. Co., Cincinnati.

Conveying Machinery.

Catalogue No. 28, illustrating and describing the full line of elevating, conveying and power-transmission machinery manufactured by this company, with price lists, tables of dimensions, a comprehensive index, and other valuable information regarding this class of machinery. Contains several views of their plant. Is well printed and is bound with a cloth cover. 6½ by 9¼ in.; pp. 736. H. W. Caldwell & Son Co., Chicago.

Crushing Rolls.

Leaflet, containing illustrations and descriptions of crushing rolls for roughing and finishing. 9 by 8 in.; pp. 6. Sturtevant Mill Co., Boston.

Digging Machinery.

Handsome catalogue covering the full line of digging machinery manufactured by the Hayward Co., with photographic views showing the well-known orange-peel and clam-shell buckets, railroad excavators, steel traveling derricks, coal handling machinery, etc., with their application. This includes their use in dredging and excavating, grading and ditch digging, for railways, dredging and deepening canals and harbors, sinking cylinders and caissons for bridge piers, well sinking and ore bed digging, rock, broken stone and phosphate dredging and placer mining. It is finely printed and illustrated. It also contains prices and full particulars. 9¾ by 11¾ in.; pp. 104. The Hayward Co., New York.

Educational.

Catalogue specifying the courses offered for the professional degrees of mechanical, civil, chemical and electrical engineer by the various departments. It also gives full information in regard to entrance requirements, courses of study, equipment, etc. 6 by 9 in.; pp. 214. Worcester Polytechnic Institute, Worcester, Mass.

Electric Hoists.

Bulletin No. 35, devoted to "Electric Hoists." It contains illustrations, descriptions, tables of dimensions and other valuable data concerning electric hoists. 11 by 8 in., pp. 10. General Pneumatic Tool Co., Montour Falls, N. Y.

Electric Meters.

Bulletin No. 3, describes a new and improved form of integrating meter for direct current. Contains illustrations showing interior views of the meter. 6 by 9 in.; pp. 8. Sangamo Electric Co., Springfield, Ill.

Feed Water Heaters.

A reprint of a paper by Reginald Pelham Bolton entitled "Circulation of Steam for Heating Purposes at or below the Pressure of the Atmosphere." 6 by 9 in.; pp. 20. Warren Webster & Co., Camden, N. J.

Friction Clutches.

Catalogue describing and illustrating patented friction clutches and cut-off couplings and friction-clutch pulleys, with their parts. 6 by 9 in.; pp. 24. Also, catalogue devoted to pulp-saving apparatus for paper mills. 6 by 9 in.; pp. 16. The Pusey & Jones Company, Wilmington, Del.

Gears.

Illustrated pamphlet, containing descriptions of the different types of gears and pinions. Contains tables giving dimensions, prices, etc. 7¾ by 9¾ in.; pp. 48. R. D. Nuttall Co., Pittsburg.

Grinders.

Pamphlet, describing and illustrating electrically driven grinders and breast drills. 3¼ by 6 in.; pp. 16. Jas. Clark, Jr., & Co., Louisville, Ky.

Imperial Air Compressors.

A 32-page illustrated pamphlet specially designed to indicate the wide variety of uses for compressed air in general manufacturing—the purpose being to show that the machinery which has proved so effective in mining, quarrying, pumping, etc., as now modified and adapted to special uses, makes air power equally effective in the machine-shop, the factory, the foundry, and especially the shipyard. The Rand Drill Co., 128 Broadway, New York.

Industrial Railways.

Pamphlet No. 051, illustrates and describes shop, self-dumping, tip, charging and foundry ladle cars. Also contains views of recent installations in machine shops, foundries, boiler rooms, etc. 3¼ by 6 in.; pp. 40. Also, pamphlet No. 052, devoted to coal conveyors, coal screens and valves, coal crackers, overhead trolleys, cable and automatic railways, hoisting engines, etc. Illustrated. 3¼ by 6 in.; pp. 20. C. W. Hunt Co., West New Brighton, N. Y.

Injectors.

Catalogue, pocket size, containing illustrations and descriptions of the Metropolitan automatic injectors, with tables of dimensions. Ejectors,

strainers, and check valves are also treated. 4 by 6 in.; pp. 48. Hayden & Derby Mfg. Co., New York.

Inspirators.

Catalogue, pocket size, giving the history of the Hancock inspirator since 1868. Also contains much vaulable information in regard to selecting the proper size of inspirator, together with tables giving dimensions, prices, etc. Fully illustrated. 4 by 6 in.; pp. 54. Hancock Inspirator Co., New York.

Lamps.

Bulletins 7030, 7035, and 7040, illustrating and describing the different types of arc lamps. 10½ by 7¾ in. Western Electric Co., Chicago.

Motors.

The Robbins & Myers Co., Springfield, Ohio, has recently issued a very comprehensive price list of their "Standard" motors and generators. It is side-pocket size and contains lists of their various types of motors as regularly furnished for various applications, from 1/16 to 15 horsepower, and dynamos from ½ to 10 kilowatts.

Paint.

"Hints on Painting Structural Steel" is the title of a booklet by Houston Lowe, vice-president of the Lowe Brothers Co., Dayton. It considers the paint, the material to be covered—steel, iron, etc.—the liquids and solids eligible for metal coverings, and the proper tests for paint users. The book is full of suggestive sentences and is the result of years of study, experiment and practice. It is unusually valuable as a practical handbook.

Power Hoists.

Descriptive catalogue showing several recent installations. Contains numerous testimonials. 6 by 9 in.; pp. 24. C. S. Harris Co., Rome, N. Y.

Radial Drills.

Catalogue, illustrating and describing the different drills manufactured and giving dimensions of same. Center grinders are also illustrated. 6 by 9 in.; pp. 12. Mueller Machine Tool Co., Cincinnati.

Rock Drills.

Pamphlet entitled "Driving the New York Subway," which gives a concise account of this great undertaking and tells of the important part played by Ingersoll-Sergeant rock drills, air compressors and other machinery in its construction, with half-tone illustrations. 7 by 5 in.; pp. 32. The Ingersoll-Sergeant Drill Co., 26 Cortlandt St., New York.

Rock and Ore Breakers.

Catalogue No. 117, illustrating and describing styles "D" and "F" of the Gates rock and ore breakers. Contains a list of the principle products manufactured by this company, together with a list of its offices and works. Allis-Chalmers Co., Milwaukee.

Separators.

Catalogue, giving a well illustrated description of Sweet's separators. 6 by 9 in.; pp. 38. Also pamphlet giving reports of tests and list of users. 6 by 9 in.; pp. 40. Direct Separator Co., Syracuse, N. Y.

Catalogue, containing illustrations of horizontal separators, together with tables giving sizes and prices. 5 by 6½ in.; pp. 16. Greenaway Co., Detroit.

Small Tools.

General catalogue 1905, covering the line of machinery and tools manufactured. Contains numerous illustrations and tables giving dimensions, prices and other valuable data. 3½ by 6 in.; pp. 494. Brown & Sharpe Mfg. Co., Providence.

Steam Turbines.

Catalogue illustrating and describing the Westinghouse-Parsons steam turbine. Contains views of different parts of the turbine, together with some recent installations. Also contains three tables giving the results of tests. It is handsomely printed. 6 by 9 in.; pp. 38. The Westinghouse Machine Co., East Pittsburg.

Steel Factory Equipment.

Catalogue illustrating and describing steel racks, tool boxes, trays, barrels, lathe pans, benches, desks, trucks, lockers, gear cases, etc. 6 by 9 in.; pp. 48. Lyon Metallic Packing Co., Chicago.

Steel Process.

Pamphlet, containing illustrations and descriptions of the Tropenas converter steel process for making steel castings direct, and of some of its characteristic products. In this process, pig iron and selected scrap are melted in a cupola and run into a small converter, where a low-pressure blast is directed above the surface of the metal, and ferro-manganese and other desirable ingredients are added. The resulting steel is intensely hot and makes excellent castings. 9 by 6 in.; pp. 29. Powell & Colué, 11 Broadway, New York.

Thermometers.

Catalogue Part 2, containing detailed description of thermometers and other meteorological instruments specially adapted for use in heating and ventilating, also in general meteorological observations. Fully illustrated. 7 by 10 in. pp 32. Hohmann & Maurer Mfg. Co., Rochester, N. Y.

Turbines.

Bulletin No. 1, containing illustrations and descriptions of very large water turbines and centrifugal pumps, with views of great installations at Niagara, Shawinigan Falls, New Orleans and elsewhere. 10½ by 8½ in.; pp. 51. I. P. Morris Company, Port Richmond Iron Works, Philadelphia.

Valves.

Catalogue A illustrating and describing the valves manufactured by this company. Contains lists of dimensions, prices, etc. Elbows and valve repairs are also given a place. 3½ by 6½ in.; pp. 32. C. W. Thomas, Detroit.

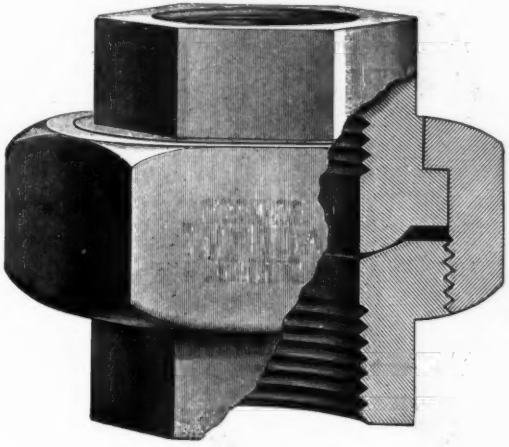
IMPROVED MACHINERY

New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

The Tuxeda Union.

As steam pressures and temperatures go up, it becomes more and more necessary to guard against leakage, and the problem of securing tight joints gets to be a difficult one to solve. The union connecting the ends of pipes is often a weak point in a plant, and may cause a great deal of annoyance and trouble, so that it pays to have one that can be absolutely depended upon.



THE TUXEDA UNION.

Such a reliable union is the "Tuxeda," which has been especially designed to meet the requirements of high-pressure steam plants, both afloat and ashore. It is made of Tuxeda bronze, a special alloy which possesses unusual soundness and high tensile strength, and is made in a way which shows a full appreciation of the exacting requirements of high pressures, superheating and continuous service.

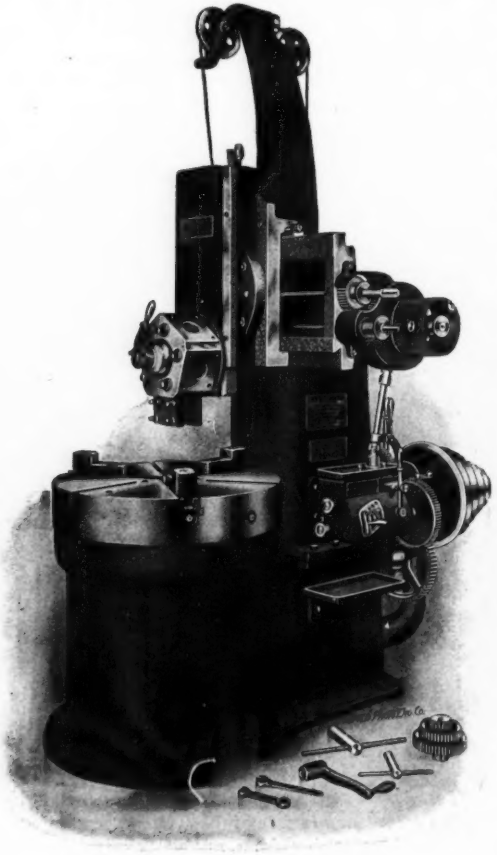
The ends are extremely heavy, thus preventing any spreading, and are hexagonal in shape, so that they can be conveniently and quickly manipulated by any smooth-faced wrench, without danger of having the edges worn down by the slipping of a monkey wrench, or marred by the jaws of a Stillson, as would be the case with round-end patterns.

The joint is made by a slightly tapered seat, to which is fitted a nose that is rounded and well ground, so that a positive surface of contact is always assured, even if the pipes are out of alignment. This self-seating feature of the union prevents any trouble arising from unequal expansions and deflections of pipes.

These unions are made in sizes up to four inches and will stand the severest usage, and on account of their long and accurately cut threads, and their general strength and solidity, they can be changed about and used over and over again without destroying their effectiveness.

They are now being specified by some of the leading engineering firms, who realize

that with up-to-date plants it will not do to leave the selection of a union to a contractor who will be guided by cheapness rather than by efficiency. Some of the great electrical power plants which have recently been erected are equipped with these unions, which are also largely used in marine work, where they give great satisfaction.



BAUSH BORING AND TURNING MILL.

The Tuxeda unions are especially well adapted for drip piping and oiling systems, for use with superheated steam and for withstanding the actions of acids in smelting and mining plants.

Further information will be gladly furnished by the manufacturer, Franklin Williams, of 39 Cortlandt Street, New York.

Boring and Turning Mill, with Swivel Turret Head.

AMONG the most recent products of the general advance movement in machine-tool design and construction is the 30-inch boring and turning mill shown in the accompanying illustration.

This mill has a swivel turret head, and is furnished with a three-jaw independent and universal chuck combined, but can be fitted with a plain table, with or without jaws. The mill swings 32 inches in diameter, and 15½ inches under the cross rail, while the diameter of the chuck is 30 inches.

The chuck or face plate has eight changes of speed, from 73 revolutions per minute to 18 revolutions per minute, without back gears, and from 9.3 revolutions per minute to 2.28 revolutions per minute with back gears, and its height above floor is 2 feet 9⅜ inches.

The chuck is bolted to a large driving gear which has an outer bearing, with automatic oiling device arranged in bed so as to keep the outer bearing continually well lubricated. The center spindle, which is 7 inches in diameter and 18 inches long, is made with an angular bearing to receive the side strains, with check nuts on the under side of the spindle to act as a precaution against any lifting tendency.

The turret slide has a traverse of 16 inches, and in the swivel head can be set over at any angle up to 30 degrees, and will face 30 inches in diameter.

The mill has arranged on its upright the Hendey-Norton change gear device for feeding and thread cutting, and it will cut the following threads: 6, 7, 8, 9, 10, 12, 14, 16, 18 and 20 threads to the inch.

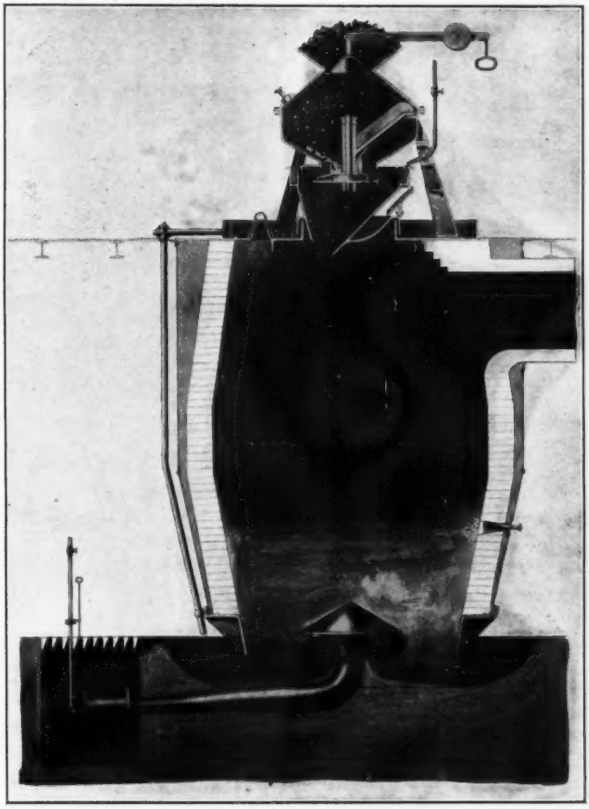
The vertical feeds have twenty changes, from .0125 to .1666 per revolution of the

table and the horizontal feeds have also twenty changes, from .015 to .211 per revolution of the table.

The mill is driven by a cone of large diameter, having a 3-inch belt, and is so arranged that it can be made with a motor drive at any time. The back gears can be changed by means of a lever, without the use of a lock-nut. The turret has five sides, 10 inches across the flats, and has five 2 3/16-inch holes, unless otherwise specified. The countershaft has a 4-grade cone with tight and loose pulleys, which should be driven at 200 revolutions per minute.

The machine is self-contained and therefore does not require an expensive foundation. It occupies a floor space 6 feet, 9 inches by 4 feet. Its net weight is 5,900 pounds and its shipping weight, including countershaft and wrenches, is 6,400 pounds, crated.

Further information will be gladly furnished by the manufacturers, the Baush Machine Tool Co., of Springfield, Mass.



THE MORGAN GAS PRODUCER.

Continuous Automatically-Fed Gas Producers.

ONE of the latest developments in the line of fuel economy is shown in the accompanying illustration. The great natural gas supplies have been both instructive and elusive. They have taught us the great benefits of gas firing over coal firing, but now that we have learned the lesson, nature's ideal fuel is rapidly disappearing and something has to take its place.

It is not generally known, but is nevertheless a fact, that practically all of the benefits of gas firing, even including the low

cost, can be and are secured by the use of the simple modern gas producer, which, fed by almost any grade of coal, converts practically the whole of its heat energy into gas, and when properly applied is as useful and economical a servant as natural gas, and far more reliable.

In a good steam blown gas producer *automatically fed,* as made by the Morgan Construction Company, the gas is of uniform quality practically every minute of the day, and with an *average* quality of bituminous coal shows the following analysis:

Carbon Monoxide (CO)	23 to 25	per cent.
Hydrogen (H)	19 to 17	" "
Hydrocarbons $\left\{ \begin{matrix} C_2H_4 \\ CH_4 \end{matrix} \right\}$	6	" "
Carbon Dioxide (CO_2).	4	" "
Nitrogen (N).....	48	" "
	100	" "

Such a gas as it leaves the producer will carry (including its sensible heat) about 180 heat units per cubic foot, and there will be from 65 to 75 cubic feet for every pound of coal, depending on the quality of the coal.

When properly applied this gas will effect any metallurgical or other melting operation requiring the highest temperatures just as perfectly and economically as annealing or heating operations at lower temperatures.

Anthracite is equally available for gas-making by this process and even its cheapest forms (buckwheat and rice sizes) work with remarkable ease and a very small amount of labor. The gas from this fuel, however, is not as rich as from average bituminous coal.

Much depends upon the way in which the gas is applied, but of first importance is the construction of the generator itself, which from being merely a closed fire-box twenty years ago, is now developed into a machine having the machine-like attributes of continuity, uniformity, reliability and economy.

The operation of plants of this character is just as simple and requires no more skill than the firing of a steam boiler. There are thousands of manufacturers in scores of different lines who are using many hundreds and often many thousands of tons of coal per annum in direct furnace firing, and paying twice as much as they should be paying for their fuel and the labor to handle it.

Such manufacturers and all others who are interested in this problem are invited to correspond with the Morgan Construction Company, 40 Exchange Place, New York City, who will gladly send an illustrated pamphlet and furnish information regarding such installations.

Disc Fan and Electric Motor.

ONE of the latest forms of the American Blower Co.'s disc fans, direct connected to a Westinghouse electric motor, is shown in the accompanying illustration.

Slight modifications have been made in the regular "A B C" fan, and the motor, instead of being attached to the arms of the fan, as has heretofore been customary, is placed upon a substantial base, resulting in a combination of exceptional rigidity and compactness.

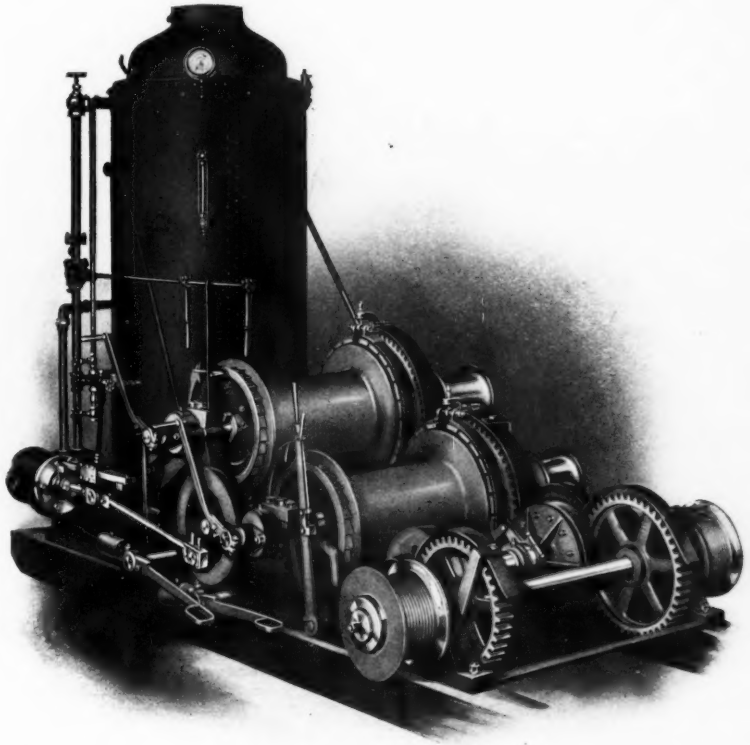
Before shipment the motor is run under load and tested for temperature, commutation and regulation, each and every part having previously been submitted to a thorough and rigid system of tests and inspection while under construction. The series wound multipolar form is used, except for the very small machines, which are made bipolar.

Free ventilation is made possible by the general design, insuring cool running under

heavy load, long life and low cost of maintenance. The bearings are self-oiling and run for weeks without renewal of the lubricant. The machine requires a minimum of care and attention during operation.

The open type of motor shown in the illustration is usually furnished. Enclosed motors may, however, be obtained at a slight additional cost where conditions require their use. Each motor is furnished with an automatic release switch and a fireproof rheostat with marble front and carefully finished and fitted working parts.

Further information concerning these outfits may be obtained by addressing the American Blower Company, Detroit.



Boom Swinging Gear for Lidgerwood Hoisting Engines.

THE Lidgerwood Manufacturing Company have already put upon the market three different types of boom swinging gear for derrick engines, each of which has demonstrated its superiority over the one which preceded it, and in the swinging gear herewith illustrated they have devised still another which, it is expected, will prove the best and most popular apparatus of the kind yet invented.

This apparatus is employed for swinging the boom of any ordinary derrick while at the same time the boom is being raised and the load hoisted, and it consists of a drum shaft, with two gear wheels and two drums, and a friction shaft and two frictions, and pinions mounted on side stands tied together by two flat steel braces, secured to the bottom of the side stands and countersunk in them, making an independent apparatus which is mounted on an extension of the engine skids, and fastened to

the front ends of the engine bed-plate. If desired the engine bed-plate may be extended and the swinging gear mounted on it.

The friction shaft is driven by a pinion, next to the winch head on the forward drum shaft, meshing with an idler gear which in turn drives a gear wheel keyed fast to the outer end of the friction shaft. There are two cone frictions on the friction shaft, the male part, carrying the friction woods, being mounted on the shaft with a feather key, and the female part being cast with a pinion and mounted loosely on the shaft. The pinion of one drives a gear directly on the drum shaft, thus turning the drums in one direction while the pinion of the other drives an idler pinion, which in turn drives the other gear on the drum shaft, turning the drums in the other direction. The drums are spirally grooved and the ropes wind over on one drum and under on the other.

Thus when the female friction is moved into contact with one flange the rope is wound up on one drum and unwound, on the other drum, and when the other friction is in contact the same thing occurs, but in a reverse direction. The ropes being attached to the bull-wheel of the derrick it is thus swung in either direction.

The frictions are applied by means of nuts, traveling on composition sleeves having screw threads which are mounted on the friction shaft and attached by suitable connections to an auxiliary shaft carrying the vertical operating lever. When this lever is in a central (or vertical) position neither friction is engaged, but when it is moved forward it causes one nut to travel on its screw and pushes one friction cone into engagement, and at the same time the other nut releases the other friction cone. When the lever is moved back the reverse takes place. One lever therefore controls the swinging of the boom in a manner that is simple and effective.

The friction cones are of a special patented type and of great holding power. The frictions can readily be replaced when worn without impairing the main parts of the apparatus.

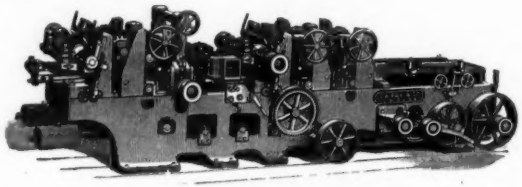
One of the swinging drums is keyed fast to the shaft, and the other is loose thereon but prevented from turning by means of a collar keyed to the shaft, on which are lugs or projections which fit into corresponding recesses in the drum. When the collar is loosened and moved back the drum may be revolved far enough to take up the slack due to the stretching of the rope, and then the collar moved back into place and secured.

The drums being outside the bearings, the ropes leading to the bull-wheel are not in the way of the hoisting and boom lines. The whole mechanism is positive, strong, and well made in every detail and adapted for the most severe service.

This swinging gear is made on the duplicate part system and all parts are easy to get at. It occupies a small amount of space, does not add much to the weight of the engine, can be operated easily and quickly. The apparatus can be placed upon any of the Lidgerwood standard double-drum hoisting engines, either with or without a boiler, which is an important feature.

The boom swinging gear is one of the most valuable improvements that has ever been placed upon a hoisting engine, as it not only largely increases the capacity of a derrick, but saves the expense of swinging the boom by hand, a laborious, slow and expensive method of doing the work.

Further information will be gladly supplied by the Lidgerwood Manufacturing Co., of 96 Liberty St., New York.



New Triple-Cylinder Floorer.

ALL persons engaged in wood-working will be interested in the new and improved flooring machine, shown in the accompanying illustration, as in certain work a flooring machine is indispensable. It has been patented, and is designed for those who make flooring, ceiling, siding, casing,

etc., in large quantities. A consideration of some of its points will prove interesting.

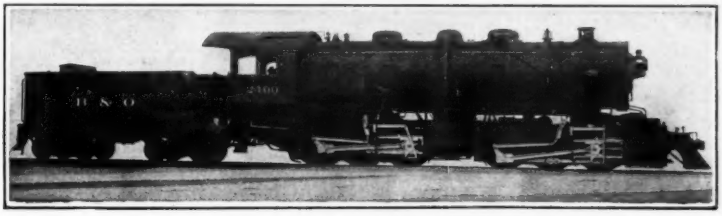
It planes four sides 9 and 14 inches wide, and up to 6 inches thick, and by the use of an endless belt apparatus, 1½-inch stock can be matched to advantage, this last device being a new feature. The massive frame prevents vibration and resists all strain, and the machine can be run at a very high rate of speed if desired, while under the absolute control of the operator.

The feed is six large powerfully driven rolls, having expansive gearing, and which can easily be raised and lowered. The feeding-out one is provided with scrapers, and the rate of feed can be furnished as desired.

The improved matcher works are very heavy and powerful in all parts; the three cylinders are four sided and slotted and furnished with chip-breaking lips to work cross-grained or knotty lumber, while the shaving hoods swing outward to give access to the knives. The pressure bars have easy and quick adjustments, and possess many improved points to facilitate their operation.

The lower cylinder is vertically adjustable at each end, and the second upper cylinder is at the feeding-out end of the machine, being designed to give a light skimming cut. It revolves at a much higher rate of speed than the other cylinders, and fine smooth work is insured, with all wear compensated by the cylinder-raising screws.

Further details, with cuts fully describing this machine, and other information, including their new catalogue, will be sent to those interested by the makers, J. A. Fay & Egan Co., of No. 212 to No. 232 West Front St., Cincinnati, Ohio.



HEAVY COMPOUND LOCOMOTIVE.

Heavy Articulated Compound Locomotive.

THE large pushing locomotive just turned out of the Schenectady shops of the American Locomotive Company for the Baltimore & Ohio Railroad is by far the heaviest and most powerful locomotive in the world, the total weight being 47,000 pounds greater than any other locomotive ever built, and the weight on drivers 100,000 pounds greater. In other words, the adhesive weight, and, therefore, the tractive power of the Baltimore & Ohio locomotive is equal to what would be obtained by adding a fifty-ton locomotive to the heaviest one already built. It should be stated in this connection that a fifty-ton locomotive was one of the heaviest in use ten years ago.

This locomotive has twelve driving wheels to distribute the immense weight, involving a total wheel base of 30 feet, 8 inches. In order to secure freedom in curving, and avoid damage to tracks, the front section of these driving wheels form part of a flexible truck, which can follow the curvature of the tracks freely. This practically reduces the rigid wheel base of the locomotive to 10 feet, which is the extreme distance between the driving wheels of each set. This principle of articulated or flexible locomotive is the design of Mr. A. Mallet, of Paris, France, and a large number of locomotives, built according to this principle, are in use in all parts of Europe.

The locomotive built by the American Locomotive Company, however, is nearly twice as large as any other locomotive of this type which has ever been built, and in fact is far heavier than any other steam locomotive in the world.

The locomotive is built on the compound system, the high-pressure cylinders being connected with the back set of driving wheels with rigid steam pipe to the boiler,

which has a steam pressure of 235 pounds. The steam is exhausted from these cylinders through a flexible receiver pipe to the low-pressure cylinders, which are carried by the forward truck, and, of course, move with this truck. The flexible receiver pipe is, of course, only subjected to the receiver steam pressure, or about 60 pounds, making it very easy to keep tight. A separate exhause valve is provided in connection with the high pressure cylinders, which is identical in design with that used with the Richmond system of two-cylinder compound locomotives. This valve permits the engine to be operated as a single locomotive, in starting, or upon very heavy grades, thus permitting an additional power of, perhaps, 20 per cent.

The use of the compound system, while essential in this type of locomotive in reducing the pressure upon the flexible joints, is also of great advantage in economy of fuel, and the trials made of this locomotive on the New York Central grade at Schenectady show extremely satisfactory results in economical coal consumption in view of the immense tractive power obtained.

The valve gear is known as the Walschaert type, and is very largely used in Europe. Its advantage in this engine, over the ordinary locomotive, is the fact that its parts are outside of the driving wheels, where they can be readily inspected and oiled, leaving the space between the frames available for the flexible receiver pipe and other parts.

The engine is reversed and the cut-off regulated by a compressed-air reversing apparatus, designed by Mr. Carl J. Mellin, who was the engineer in charge of the design of this locomotive. This power-reversing gear has worked very satisfactorily, and it will be of great help in reducing the work required by a locomotive engineer in handling this immensely powerful machine.

The tender, and a large part of the details of the locomotive, are Baltimore & Ohio standard, and the engine will be used on the B. & O. for pushing service on their heavy grades.

The locomotive has been designed with great care, with a view to maximum durability, and freedom from breakdowns, and it is noteworthy that the locomotive was finished complete without a hitch or interference of any part with another, the design working out exactly as planned in every respect. The weight distribution especially is exceedingly satisfactory, there being a difference of only 900 pounds between the weights on the back and front sets of driving wheels, and considering the fact that no locomotive of any such size has ever before been built, and that the design was practically new throughout, this statement shows the great accuracy of the calculation made.

Notwithstanding the immense weight and power of this locomotive, the fact that the driving wheels and cylinders are divided into two sets, enables the parts to be made of ample strength, and yet with reasonable weight, the connecting rods, crossheads, and all parts of the valve gear being considerably lighter than those used on many of the heavy locomotives of the ordinary type.

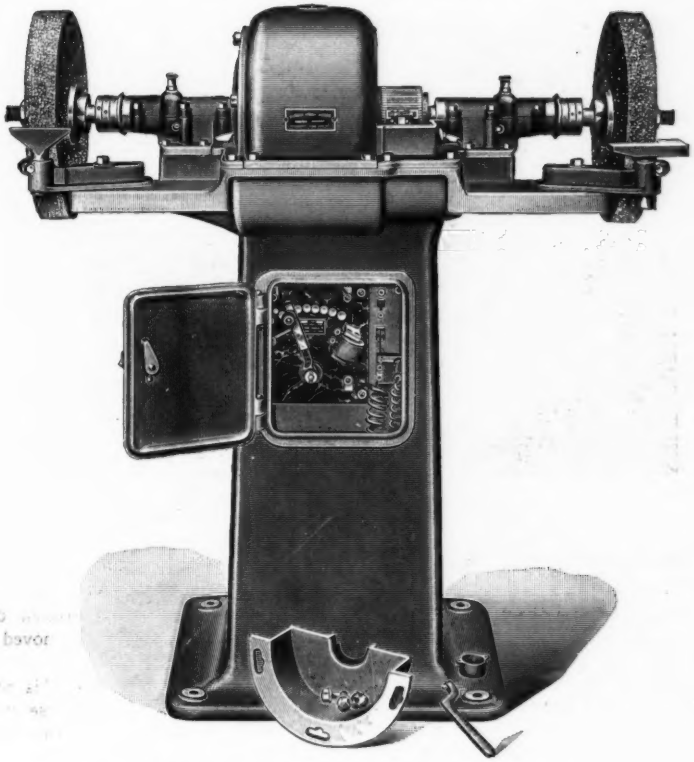
In case the machinery in connection with one set of driving wheels becomes disabled, the locomotive could be run at one-half its power with the remaining set, and the change in this respect could be accomplished with very little difficulty, and by a locomotive engineer on the road.

Further information regarding this locomotive will be gladly supplied by the American Locomotive Company, of 25 Broad St., New York.

Motor-Driven Buffing Lathes and Dry Grinders.

IN order to supply the demand for effective electric motor-driven buffing lathes and dry grinders a line of these machines has been placed on the market by the Bridgeport Safety Emery Wheel Company and the Crocker-Wheeler Company. It is a complete line of motor-driven tools of this class of extremely neat and effective construction. Instead of extending an ordinary motor spindle and making a base to fit the motor, the emery-wheel builder supplies shafts upon which the Crocker-Wheeler Company mount their armatures. The shaft is larger and stronger than necessary for an ordinary motor shaft and is supported by unusually long bearings to secure rigidity against the vibration to which these tools are subject. The design of the motor is slightly modified to make the two a harmonious unit in every particular.

Machines of this class must of course be



ELECTRIC MOTOR-DRIVEN GRINDING MACHINE

fully inclosed and the problem of cooling by air is a serious one. This has been solved by having the lower half of the motor open directly into the base casting. The air contained in the inside of the base is thus added to the quantity that circulates around the inside of the motor, and enables it to run much cooler than an ordinary fully inclosed motor of the same size and capacity. By this means of inclosure from five to eight times as much cooling air is available as in ordinary fully inclosed motors of equal power, the base also giving an increased surface from which to radiate the heat.

The armature and brush mechanism is covered with an end shield, split horizontally. The lower half contains the brush holders and wire connections; the upper half is attached to the motor frame by cap screws. This upper half of the frame can thus be readily taken off, giving quick and easy access to the armature and brushes.

The machines are equipped with ring oiling bearings. On the outer end of each box is a dust-proof collar, held in place by a key with two ring nuts, to compensate for all end wear and thrust of the spindle. The machines are strong, rigid, compact and self-contained. All wires and connections being inside, a short circuit through outside terminals is impossible. The starting box and switch are inside the base and are easily reached by the operator through a door. The machines can be used with either underneath or overhead wiring as desired, and are complete with starting-box with no-voltage release, knife switch, and fuses ready to connect line wires.

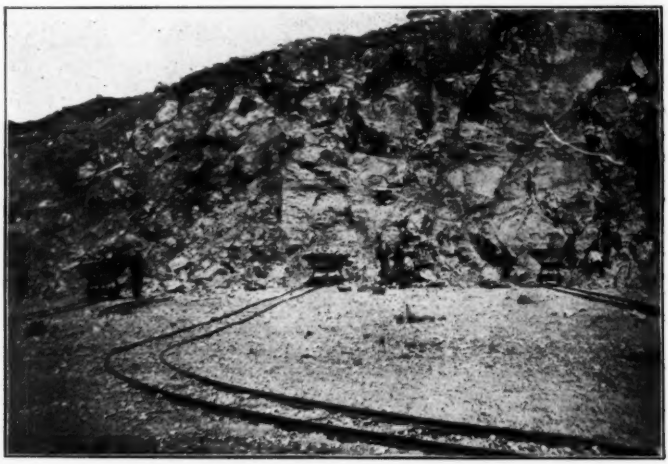
Any further information desired will be gladly furnished by the Crocker-Wheeler Company, of Ampère, New Jersey.

NARROW GAUGE RAILWAY IN CEMENT QUARRY.

Narrow-Gauge Quarry Railway.

THE accompanying illustrations show an a complete railway installed and equipped by Arthur Koppel in a cement quarry. This railway consists of 25-pound rails spiked down to wooden ties for the permanent road, and 16-pound portable track for use in transporting the rock from where it is quarried to the permanent road. The portable track is made in sections, each weighing about 250 pounds, and mounted on steel ties, so that it can easily be laid, without any previous preparation of the ground, and can readily be moved from place to place as required.

Eight switches for use with this portable track were also furnished. These switches are made as standard in two different lengths, viz., 9 feet and 15 feet, to match track, and for 12-foot and 30-foot radius.



CEMENT QUARRY RAILWAY.

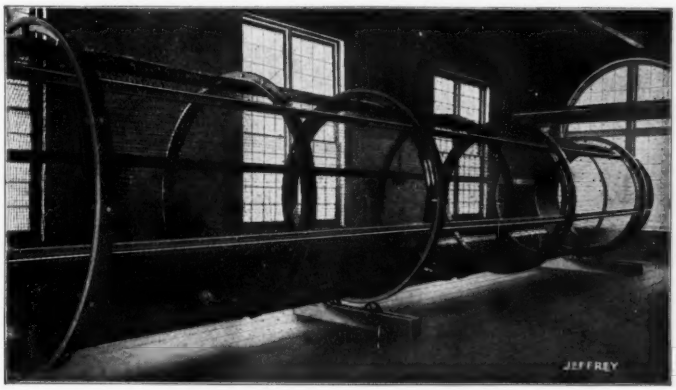
CEMENT QUARRY RAILWAY.

There were also furnished thirty standard steel side-dump cars, dumping to both sides, each with a capacity of 1½ yards. These cars were fitted with Arthur Koppel's patent roller bearings, which effect a saving of about 50 per cent. in haulage power over cars fitted with ordinary axle boxes. These bearings are practically dust and dirt proof, but can readily be cleaned when necessary. There is also a considerable reduction in consumption of oil, as none is required for lubrication, only just sufficient oil being put into the bearings to prevent the rollers from rusting. All this material was for the Koppel standard narrow gauge of 23⅝ inches.

This system of narrow-gauge railways is suitable for all classes of manufacturing, mining, building, contracting, etc.; a large saving can be made and materials can be handled quickly, economically, safely and systematically by installing such a road. Further information and a complete catalogue will be sent on request by Arthur Koppel, of 66 and 68 Broad St., New York.

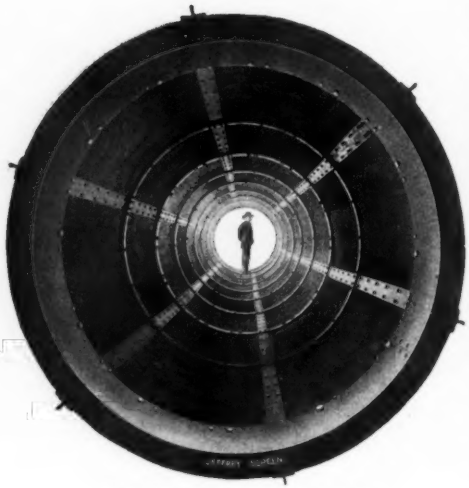
Large Revolving Screen.

THE accompanying illustrations show extraordinarily large revolving screen, 7 feet in diameter and 54 feet long, mounted on friction rollers. This screen is for separating coal into a number of sizes and was built especially for one of the large coal companies in Virginia.



THE JEFFREY REVOLVING SCREEN.

When installed at the mine the screen will have no central shaft, but will be supported on heavy friction rollers, carried on



THE JEFFREY REVOLVING SCREEN.

shafts extending the full length of the screen. By rotating these shafts the motion is imparted to the screen by the friction rollers on the shafts bearing against the friction rings which are attached to the outside of the screen.

The coal is fed into the screen by means of a special bucket elevator at the rate of about 250 to 275 tons per hour.

This type of screen is also used, in a large number of mills, for screening shavings in great quantities.

Further information concerning this giant screen as well as their many other products will be furnished, upon request, by the Jeffrey Manufacturing Company, of Columbus, Ohio.

The Perry Time Stamp.

A TIME Stamp which will print anywhere, on anything, without the clock work receiving the least shock or jar in the operation of positioning the Stamp and making the impression, must be pronounced perfect if there can be such a thing. Furthermore, when all this is achieved without complexity or weakness, it leaves little to be desired.

The Perry Time Stamp Company has accomplished all this in their model "C" Stamp, which resembles the well known, long tried, successful self-inking Stamp, the difference being that the Time Stamp is very much heavier and stronger in all respects and is provided with clock work and dials.

The clock work is mounted upon the base plate which joins together the two side frames. Intervening between the clock work and the base plate is a series of springs. These springs receive and absorb all jar or shock there may be when the stamp is placed upon the document, time card, box or parcel receiving the impression. Further, the blow or pressure given the handle to make the impression passes by on either side of the clock work directly to the type plate and is received by the object stamped and its support. By this construction, the unavoidable jar or shock in making an impression cannot reach or affect the clock work in the least.

THE PERRY TIME STAMP.

The ink pad is in its usual location on the bottom of the base plate. On the type plate is a simple dial train, the hour, minute and A. M. and P. M. hands of which rest against small circular rotating ink pads thereby putting no drag or work upon the clock motor.

The impression is made from rubber type, which prints more distinctly and wears better than the usual ribbon.

The hands in the dials are firmly locked in position the instant the type plate leaves the ink pad, thereby making it impossible for anything but the correct time to be registered. No one can tamper with the clock or alter its time, unless in possession of a special setting key provided by the manufacturer with each stamp.

The clock work is an excellent timekeeper. It should be wound each morning, the operation taking but a few seconds. The year, month and day are set by hand, a simple process common to all dating stamp.

These stamps have had the test of severest usage for almost one year in such places as the Chicago Stock Yards, where several thousand impressions are made daily, with the result that they have proven a durable, reliable and valuable device. With ordinary use they should last several years. The manufacturers guarantee them absolutely for one year.

This stamp makes it possible for the small manufacturer to introduce into his office and his works the many excellent cost keeping systems, nearly all of which call for an expensive clock or recorder. It also makes it possible for the larger institutions to introduce the time stamp into other departments where they have been prevented from so doing on account of the large expense involved in the introduction of the electric and other clocks. Besides being a simple, practical and effective business machine, the stamp is also an ornament to anyone's desk.

Any further details of construction or use of the stamp will be cheerfully furnished by the manufacturers, the Perry Time

The advantages of mechanical recorders of time are being more and more appreciated everywhere, and this improved machine will doubtless be welcomed.

Stamp Co., 72 South Canal st., Chicago.

The Jackson Belt Lacing Machine.

THESE machines are built in four sizes, 6", 12", 18" and 24". This designation of sizes in inches arises from the maximum width belt each machine is capable of lacing. The machines are operated by hand, though the two larger sizes are equipped with power equipment if desired. These machines will lace belts made of any material.

The operation consists first in squaring the end of the belt by means of the cutter bar seen on top of the machine and a specially constructed knife furnished with the machine. The end of the belt being made square, the belt is clamped firmly between the jaws by means of the levers and the end punctured by means of a spiral needle. The needle is driven ahead by means of three grooved rollers which are revolved by means of the crank. Following the needle the coiled wire is inserted and enters the holes punctured in the belt by the needle. The lacing being in the belt it is removed and the surplus wire cut off with pliers. The wire is then flattened between the jaws until it is flush with the surface of the belt. The other end of the belt being laced in a similar manner, the two ends of the belt

being brought together, the lacing meshes and the ends are held together by means of twine, lace leather, raw hide or metallic pins. This lacing costs one-fourth as much as lace leather or clamps per inch of belt. It lasts several times longer and can be inserted much more quickly and is equally as efficacious as endless belts. Further information may be had from the Diamond Drill and Machine Co., Birdsboro, Pa.

THE POOL ROD CUTTER AND POINTING MACHINE.

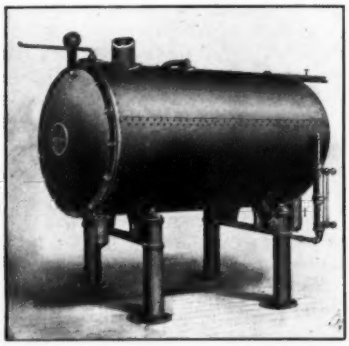
The Pool Rod Cutter and Chaplet Pointing Machine.

THE machine consists essentially of a pair of knives, and a chuck for holding the chaplets.

There is a gauge on the machine showing the length chaplet will be after it is pointed.

In operating it, the chaplet is first placed in the chuck, and a downward stroke of the lever makes a beveled cut on the end of the chaplet. The chuck and chaplet are then rotated through an arc of 90 degrees and another cut made. This work has heretofore been done either by the blacksmith, or on an emery wheel, and much time has been lost in doing this work.

This machine is made by the J. D. Smith Foundry Supply Co., Cleveland, O.



THE HOPPES FEED-WATER HEATER.

A New Plan for Supporting a Hoppes Feed-Water Heater.

WITH a view to the better utilization of space, the Hoppes Manufacturing Company, of Springfield, Ohio, have designed a new method for supporting their feed water heaters which is clearly shown in the illustration. Sockets of ample size and strength are provided on the heater for receiving and holding four iron pipe columns with flanges at their lower ends for resting on the floor or foundation. This makes it possible to set the heater at any desired height and the boiler feeder or other auxiliaries may be placed under the heater and valuable space saved. The makers will furnish their cast iron or steel type of heaters with sockets and flanges when specified with the order, without additional cost to purchaser.

IMPROVED MACHINERY

New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

The Pelton Water Wheel.

AS is doubtless known, the impulse wheel, of which the Pelton is the pioneer, consists essentially of a cast iron or steel center, to the periphery of which are affixed cups or "buckets" as they are technically called. Water under pressure is allowed to impinge on these buckets, causing the wheel to revolve with the shaft on which it is mounted.

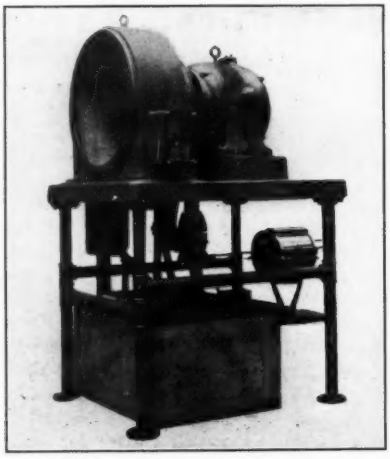
The efficiency of a wheel of the Pelton type is, to a very large extent, due to the shape of the bucket, and as efficiency is a most important factor in the development of every power proposition, it is the bucket and the action of the water upon it which engage the most attention.

SKOBISCOPIC VIEW OF PELTON WHEEL IN OPERATION.

One of the fundamental principles of hydraulics as applied to impulse wheels, is that the water must "enter without shock and leave without velocity." The nearer the approach to this condition, the higher will be the resultant efficiency. Early experiments with the Pelton bucket demonstrated the fact that in order to obtain a complete reversal of the stream, with practical absence of velocity, it was essential that the bucket be divided into two parts, by a wedge or splitter on which the stream might strike. The stream of water was thus divided, the two halves following the curvature of the bucket and discharging backward and downward at a slight angle, so as to avoid interference with the succeeding bucket. To obtain this result, it is necessary that the bucket curves be laid on lines of the least resistance and that the splitter bear a certain relation to the bucket sides.

In designing a water-wheel bucket and attempting to carry out a particular theory, it is, of course, necessary to lay out the bucket shape mathematically, and then, following well known hydraulic laws in regard to the flow of water on surfaces, note the curves and paths which the stream should follow. This plan—the only one heretofore known—has been productive of some excellent results, but the fallacy lies in the fact that most of the hydraulic laws above referred to were deduced from observations of water action against *stationary* surfaces; or, if moving, the path of the water was so obscured by spray and the moving wheel, that the observations have in some cases led to mistaken theories, which are now disproved in actual practice.

The problem is, then, to observe the action of water on moving surfaces as though

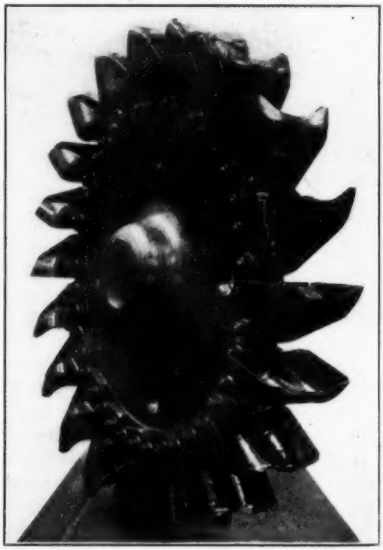


SKOBISCOPIC APPARATUS FOR PELTON WHEELS.

they were standing still. This is accomplished by applying the "skobiscopic" principle to the observation of a water wheel in actual operation, which principle may be described as being the reverse of the kinetoscope, in that moving objects are seen as stationary, instead of apparent motion being given to stationary objects. The general principle is that if a moving object be illuminated at fixed intervals by rays of light admitted at the moment the object passes a desired position, each portion of the object will be observed as though it were stationary. Thus is secured a clear view of what occurs in the buckets of a water wheel while it is operating under normal conditions.

The Pelton Water Wheel Company has made extensive experiments on a large scale at its San Francisco laboratory with apparatus embodying the above principles, and has also shown similar apparatus on a smaller scale in action at the St. Louis Exposition. The latter outfit consists of a Pelton water wheel 20 inches in diameter, mounted on the shaft overhang of a General Electric generator. The water impinges on the wheel through a needle nozzle, the pressure being supplied by a centrifugal pump. The illuminant is a General Electric searchlight projector with automatic focal point control, which is located beneath the apparatus, and which by a system of mirrors, throws its rays into the wheel housing through the glass bottom. In its normal position the light is thrown direct on the wheel, under which condition the wheel may be seen revolving and the water discharging from the buckets in apparent confusion. Interposed between the searchlight and the wheel is a sheet iron disc with radial slots, which disc is revolved by means of gearing at a speed proportional to that of the wheel, and when the searchlight is automatically brought into its upper position, the light is thrown on the wheel *through* these revolving slots, and thus the wheel is illuminated at fixed intervals, as explained above, and one sees the wheel apparently standing still and can observe the action of the water and trace the path of the jet from its entering the bucket to its reversal and clearance of the succeeding bucket, without interference.

At the San Francisco laboratory of the Pelton Water Wheel Company reliance is not placed on visual observations alone, but resort is had to photography as a permanent aid in studying the action of the water on the buckets. In this laboratory also are instruments of precision for determining the relative efficiencies of different bucket shapes; and to such an extent



4,000 HORSE-POWER PELTON WHEEL.

is the investigation carried that it may be said that there are practically no "standard" buckets used in the construction of Pelton wheels, a new design being adapted to the head, water quantity and power requirements of each installation, thereby insuring the highest possible efficiency.

Further information about these investigations and their apparatus in general may be obtained from the Pelton Water Wheel Company, of San Francisco.

The Saving of Oil By Filtration.

IN every engine room, and indeed, in every factory and mill where a large amount of machinery, and long lines of shafting, are in operation, there is a great waste of lubricating oil, owing to the fact that in many instances no provision is made for catching the oil after it passes through the shaft or engine bearings. This is often due to the style of bearing used on the shaft lines, but where suitable self-oiling bearings are installed and provision made for catching the drippings which accumulate in the drip cups, or where provision is made for catching the oil after passing through the engine bearings and then purifying these drippings through an oil filter, a surprise is in store for the manager in the shape of a great reduction in the size of his oil bills for the month.

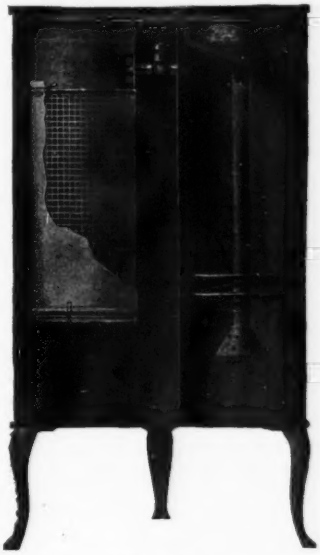
Every engineer appreciates the value of good oil and asks his employer to procure the best in the market for lubricating purposes, for the proper preservation of machinery in his care demands it. Getting a good grade of oil, the engineer will naturally be glad to use some filtering device for purifying the oil which has passed through the bearings, thus permitting its use over and over again.

An interesting test conducted by users of the White Star oil filter as manufactured by the Pittsburgh Gage & Supply Co., was recently conducted, and in the case of O. J. Beaudette & Co., of Pontiac, Mich., it was found that in the first six months operation of the White Star filter, a saving of 364 gallons of oil, of a value of $54.60, was effected. As the original cost of the filter was but $28, the effectiveness of the device and profitableness of the investment is apparent.

Another instance of interest is the experience of the City Water Works, of Marietta, Ohio, where, before purchasing a White Star filter, they were consuming a barrel of oil every two months, but with the filter in use a barrel now lasts them four months.

The effectiveness of any device depends upon its design, construction and workmanlike qualities, and in the White Star oil filter is found the essentials of a complete device for accomplishing the purifying of dirty, or used, lubricating oil.

As seen in sectional view, the filter is divided into two compartments. The smaller one is a reservoir for impure oil and water,



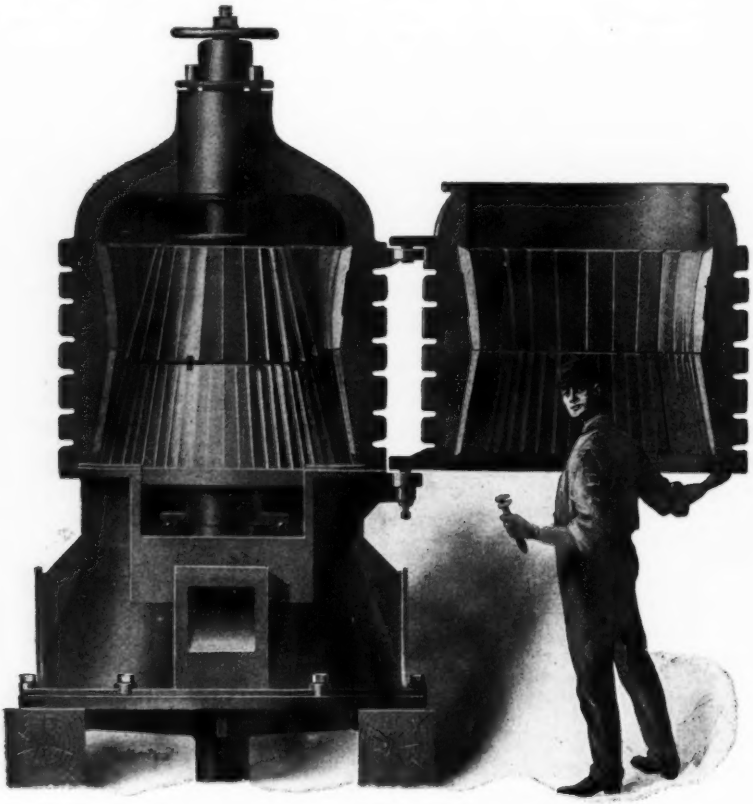
WHITE STAR OIL FILTER.

containing a funnel for receiving the dirty oil and the steam coil for heating the water.

Impure oil is poured into the funnel, drains through the sieve and is discharged below the surface of the water through holes in the foot of the tube. The thinning of the oil by its exposure to the heat in passing through and resting on the surface of the water promotes the precipitation by gravity of all heavy particles of grit and dirt, the accumulation of which at the bottom can be quickly flushed out by opening the faucet for this purpose, which may also serve to drain off any excess of water in the chamber.

When sufficient impure oil has beeen introduced to reach the level of the inlet pipe, it flows into the filter cylinder which is suspended in the larger compartment. This cylinder is unique in that it consists of a sheet metal neck and bottom with a section of coarse wire mesh between, around which several layers of cloth are wrapped. The oil in passing out of this cylinder through the cloth is thoroughly and quickly freed of every remaining impurity and accumulates in the surrounding chamber, which comprises the remaining two-thirds of the filter, so giving the White Star filter a great storage capacity for pure oil.

The filtering cylinder and every part of the filter may be quickly and easily removed and cleaned, enabling the apparatus to be always kept in perfect filtering condition. In this most essential feature of a perfect and complete device the White Star oil filter is unsurpassed, and further particulars will be furnished on request by the Pittsburgh Gage & Supply Co., of Pittsburgh.



STURTEVANT OPEN-DOOR ROTARY CRUSHER.

Open-Door Rotary Crushers.

A NEW rotary crusher is manufactured by the Sturtevant Mill Company, the ingenious and practical design of which will certainly interest all crushers of materials of moderate hardness. It is called the open-door rotary fine crusher, and its massive door, swinging wide as easily as the great door of a large safe, exposes all its wearing parts to quick inspection and removal. It is obvious that railway links,

coupling pins, and all sorts of uncrushable materials that get into this class of machines, and are so difficult to get out, may in this machine be removed in short order.

Also, the heaviest wearing parts, although massive, are small enough to be lifted out by hand, obviating the necessity of the hoisting appliances in common use. These crushers are large, and yet far more convenient than others of even small size.

Rotary crushers are the greatest producers known of finely broken materials of moderate hardness, and are more widely used than any others. They have held their own against all comers, notwithstanding the frequent annoyance of having to dismantle them completely to remove foreign material getting wedged among the crushing members, for they crush cheaply, and crush fine, and are the least expensive in first cost as well as in power. But for big works they could not be made large enough until this open-door crusher was designed.

The vertical shaft carries only its own weight and that of the driving gear; and its foot runs in a large oil-pot bearing thoroughly protected from dust. The crushing cones are supported from the top by large ball bearings, which greatly promotes easy running and durability. These cones may be raised or lowered by the screw at the top. The range of adjustments for wear, or for size of output, is unusually large.

The scrapers require no change, except replacement for wear, and are conveniently reached without dismantling the machine. The cast-steel bevel pinion shaft is supported from the inner end, so giving great strength to this important part. Discharges are from three sides. The door bolts are removed from slots, a single turn of each nut allowing speedy removal, and thus the door may be opened as easily as the door of a steel safe, and swung entirely out of the way, giving full access to the interior of the crusher. Removal of any part is therefore easy. The case is not weakened by the door which, held by its bolts, is rigid and secure.

Having no fly wheel, this crusher is not subject to breaking fly-wheel shocks in case of sudden stoppage. This danger is avoided, and yet the machine has abundant power for any work.

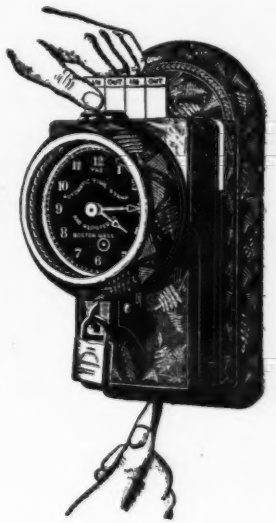
Every part of the open-door crusher is massive; the main shaft is 7 inches in diameter, and in every way strong and reliable.

The Sturtevant Mill Company, of Boston, have just issued their 1905 Catalogue No. 12, showing and describing these rotary crushers and eight other types of rock crushers, as well as rolls, mills, screens, engines, boilers, etc., and they will be pleased to mail this catalogue to interested persons.

Employees' Automatic Time Register.

IN the modern systems of works management it becomes of the highest importance to keep an accurate record of the time of every operation, as well as to register the there have been several machines designed to perform one or the other of these functions.

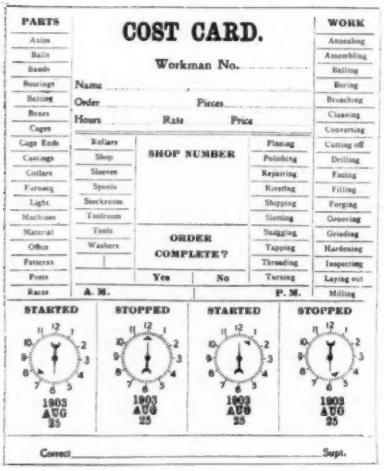
An apparatus which will accomplish both these results is shown in the accompanying illustration. For registering the coming and the going time, it is operated by the employee taking a ticket bearing his name or number, or both, from a pigeonhole similarly marked and inserting it in the time-stamping slot and pushing a trigger lever which imprints the exact hour and minute and the date upon it.



EMPLOYEES' AUTOMATIC TIME REGISTER.

The daily-strip ticket usually has room for four "In" and "Out" impressions, and the weekly strip is designed to receive twenty-four impressions, but the number of time-imprint spaces may be varied as required.

This machine is also most convenient in cost-keeping systems for recording the time required on any operation, and in establishments where the workmen make out a daily report slip of their work and time, their "In" and "Out" records can also be registered upon it, and will thus verify their reported time without adding to the clerical



COST CARD OF THE AUTOMATIC TIME STAMP COMPANY.

work or increasing the expense in any way. A typical cost card is shown in one of the figures.

It is evident that this machine may be worked with a variety of specially arranged tickets, as may be desired. As the vertical spacing lines on the tickets coincide with gauging pieces on the machine, the tickets can be quickly placed in the proper printing position without the slighest difficulty.

This machine is of very simple construction, the number of parts being small and the operation not at all complicated. Further details and all other information desired will be furnished on request by the manufacturers, The Automatic Time Stamp Company, of Boston.

Revolving-Cylinder Gasoline Motor and Car.

A REVOLVING-CYLINDER, air-cooled, gasoline motor, which is claimed to have distinctive advantages because of its compactness, its perfect balance, light weight, wide range of speeds and power and practical air-cooling qualities under all conditions, has been brought out by the Adams Company, of Dubuque, Iowa.

It reverses the ordinary practice, in that the engine cylinders revolve and the crank shaft is stationary, instead of the crank shaft revolving and the cylinder being stationary, but it is not what is usually termed a rotary engine. Three units, each being a complete cylinder, with cylinder head and one-third of a central crank case cast in one piece, are bolted together and bolted to a top and bottom cast-steel flange, which has bronze bushings forming bearings around the vertical stationary crank shaft. This forms the revolving unit and is, of course, balanced perfectly. This revolving unit in a twenty-horse-power engine, with 5-inch bore and 4½-inch stroke, weighs 190 pounds and forms the fly wheel.

In each cylinder is a cast piston having four rings. The three pistons are connected to a single crank wrist pin of very large proportions by bronze pitmans. The pitmans, with the piston at their outer end, swing around the stationary wrist pin in practically perfect mechanical balance. The wrist pin being eccentric with the axis of the revolving cylinder unit, the pistons are caused to reciprocate back and forth in the cylinder at each revolution of the revolving unit, although the speed of the mass of the pistons does not change or stop and return at each dead center, as with the ordinary engine. It is, therefore, susceptible to a very perfect mechanical balance. The action of the exploding charge is practically the same in this engine as in the ordinary kind, except for the smooth running caused by the variable-compression control.

The lack of vibration of the motor is attributed to the perfect balance of the revolving parts, the manner of revolving the cylinders in a horizontal plane around a vertical axis and the novel way of controlling the speed of the motor by a variable compression system.

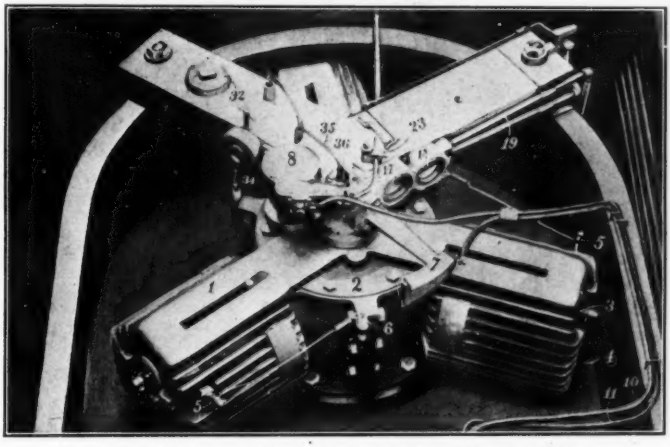
The light weight of the motor, as com-

pared with the three-cylinder motor of the ordinary type having the same power and cylinder sizes, is brought about, not by sacrificing the strength of any of the parts, but by eliminating many parts found necessary in the engine of the ordinary type.

No muffler is employed. Because of the velocity of the cylinders passing through the air a muffler of the ordinary type may be entirely dispensed with. Auxiliary exhaust ports, which let out the high terminal pressure against the rapidly receding volume of air, are used. The discharge acts upon the air like a sky rocket and not like a gun.

Air cooling is effectually accomplished by the cylinders revolving at a rapid rate, drawing in the air at the center of the engine, or inner ends of the cylinders, and expelling it with great rapidity at the periphery, or outer ends of the cylinders. The cylinders are provided with longitudinal ribs cast integral with the cylinders, which provide a large radiating surface.

The speed of the motor is controlled entirely by the Adams-Farwell variable-compression system, which consists in allowing that part of the charge not needed to give the motor the required power to escape back by the inlet valve, which is mechanically held open for a part of a compression stroke; that part of the charge so escaping being drawn in by another cylinder. There is no waste of the gases. When the maximum power is required the inlet valve is closed at the end of the suction stroke and the full charge is compressed to about 95 pounds per square inch. When minimum power is wanted, the inlet valve is not closed until the completion of the compression stroke, and an exceedingly small part of the charge is retained and ignited at atmospheric pressure, giving a gentle expansion. Variable compression is the entire source of control. This system of control is claimed to be very economical, to be conducive to very smooth running, to obviate the necessity of heavy exhaust valve springs, to run much cooler and to keep the cylinder heads and spark plugs entirely free from sooty deposits.



ADAMS-FARWELL REVOLVING-CYLINDER GASOLINE MOTOR.

The carburetter is entirely automatic at all speeds, no attention being required after once adjusting.

The spark is regulated automatically by the Adams-Farwell automatic spark regulator, which fires the charge at all speeds at a point that produces the greatest efficiency. This is a device employing a centrifugal governor which not only advances the spark when the speed of the engine increases, but also increases the length of the contact of the primary circuit. A contact of the primary circuit for 1-36 of a revolution of the engine gives sufficient time for the spark coil to become saturated and give a good spark when the engine is running 150 revolutions per minute, or less. This

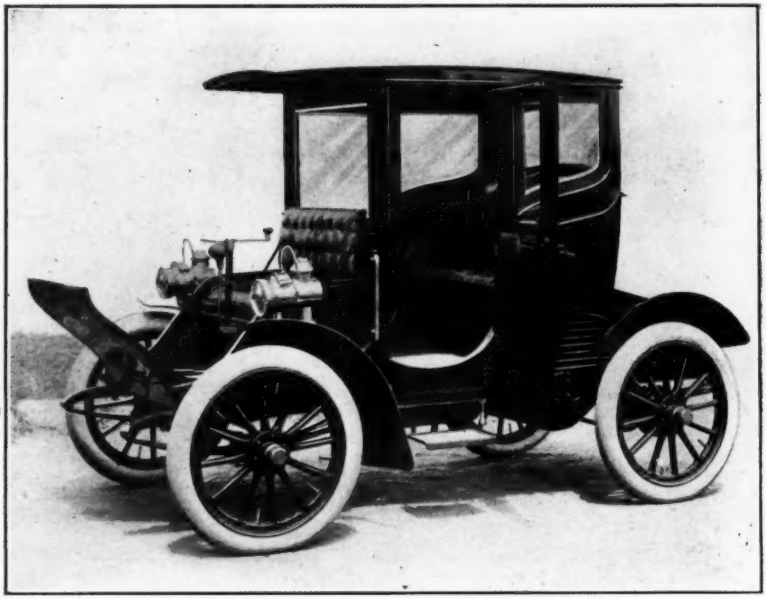
contact is automatically increased to about 1-12 of a revolution of the engine when running at 900 revolutions per minute.

One of the illustrations shows the motor as situated in the rear of an automobile body, where every part of the motor proper that will ordinarily require examination or adjustment is exposed to view and is readily accessible, as well as every tool required in these adjustments, each in a separate pocket, so that a glance will tell if all necessary tools are aboard. Two sets of batteries, a spark coil and a double-throw switch, and a few extras also find a place in the rear compartment of the car body.

The complete power plant, including all parts of the motor, transmission, oil tank and pump, carburetter, clutch operating cams, and so forth, are secured to the bronze supporting spider, forming an integral power unit weighing 387 pounds. Of this, 157 pounds belongs to the parts of the transmission which would not be needed if the motor was used for other purposes than that of automobile propulsion. Of the 230 pounds, the weight of the motor proper, 190 pounds are in the cylinders and other parts forming the revolving unit or fly wheel.

Another illustration gives a view of a convertible brougham equipped with the gasoline engine which has just been described. This car, known as Model 6, which is the latest style built by The Adams Company, is enclosed by plate glass in substantial frames, sliding in rigid pillars which support a solid roof, and makes an ideal vehicle for all seasons.

As shown, the forward seat is open and the car is operated from there, but this seat can be folded up so as to form a hood and the controlling levers can be moved to the rear.



ADAMS-FARWELL CONVERTIBLE BROUGHAM WITH GASOLINE MOTOR.

All the novel features of these motors and cars, such as revolving the cylinders around a vertical, stationary crank shaft, the system of muffling, variable compression control, automatic spark regulator, control from either front or rear seat, variable-strength springs, carburetter, oiling system, etc., are the subjects of patents granted and pending in the United States and foreign countries.

Further information concerning these gasoline engines and their various styles of automobiles may be obtained from The Adams Company, of Dubuque, Iowa.

IMPROVED MACHINERY

New Processes and Appliances

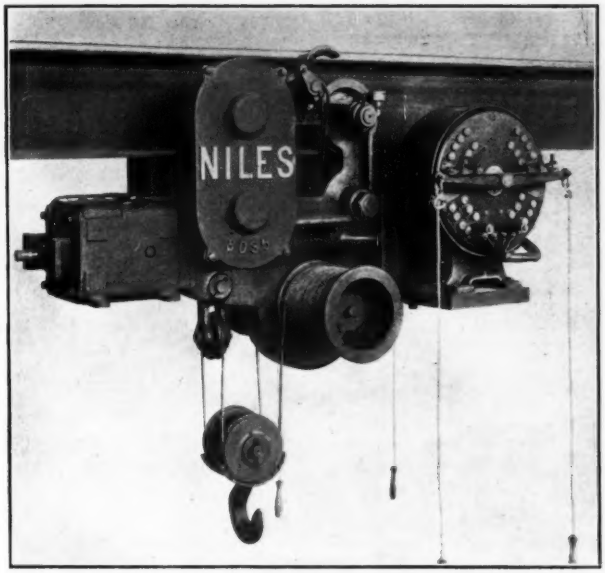
The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Electric Traveling Hoists.

ELECTRIC traveling hoists are rapidly coming into favor, and many of the more progressive shops are installing them in place of hand hoists.

Besides the direct advantage of handling loads vastly quicker than the hand hoist, the electric traveling hoist has the indirect advantage of increasing the output of a shop by waking up the men. The hoist moves so rapidly that it compels the workmen to be quick in their movements, and instinctively they do their regular work more quickly. On the other hand, if the workman is using a hand hoist, he is pretty well tired out after he has lifted a load, and does not return to his regular work with much vigor.

The illustration shows a new type of Niles hoist built in capacities of 3/4 to 6 tons, that may be used either as hoists, in which case they run on an I-beam track, or when mounted on a traveling bridge they may be used for small capacity cranes. In the latter case they are arranged to run between the two I beams or channels of the bridge, and the controllers for raising and lowering the hook and operating the traversing mechanism may be placed either on the hoist, on the bridge and operated by cords from the floor, or in an operator's cage attached to the bridge.



NILES ELECTRIC TRAVELING HOIST.

When used on an I beam, the controllers are attached to the hoist and operated by cords from the floor. These hoists will run on straight and curved tracks and are usu-

ally provided with a separate motor for traversing, but if desired, hand traverse may be furnished, or all the traversing mechanism may be omitted and the trolley moved along the track by pushing on the load. The increased service of the electric traverse, however, much more than compensates for the slight additional cost.

The hoist is self-contained in one heavy cast-iron frame to which the motors are attached end on, and the power is transmitted directly from the armature shaft to the drum shaft through one train of worm and worm-wheel gears.

The traversing mechanism is also driven through one train of worm and worm-wheel gears similar to the hoisting mechanism, except that when the trolley is arranged to run on a single I-beam, a double set of transmission gears is used to connect the worm-gear shaft to the truck-wheel shafts. All the mechanism is enclosed in oil- and dust-proof casings and is absolutely noiseless in operation.

In addition to the braking effect obtained by the use of the worm and worm wheel, a powerful electric brake is attached to the hoist motor.

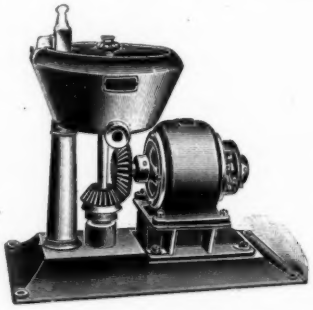
Further information regarding these hoists may be obtained from the builders, Niles-Bement-Pond Company, 136-138 Liberty Street, New York.

Electrically Driven Centrifugal Oil Separator.

AN electrically driven centrifugal oil separator, with which motors for any voltage can be furnished, is shown in the accompanying illustration. This apparatus is especially designed for use in machine shops and similar establishments, to separate the oil from chips, turnings or cuttings of any kind, and from small work of all kinds that is made on screw or other machines, where oil is used in the operation.

With this machine oil can be separated and used again almost indefinitely, there being, of course, some waste, but little in comparison with that where no separator is employed. The large amount of oil annually wasted is a strong argument in favor of the use of such a machine.

These oil separators are well made, compact and durable. The spindle quill, or step, is positioned between rubber springs, and all these parts are held in a casing in the base of the machine by a screw gland, so that the proper operation can be obtained by varying the tension of this gland. An inner pan, with bronze sleeve surrounding the spindle is provided, having a capacity of 750 cubic inches, this pan being removed



CENTRIFUGAL OIL SEPARATOR.

to empty the contents after the oil is extracted, which ordinarily takes from 5 to 8 minutes.

The weight of the machine shown is 525 pounds, and it has a speed of 1,800 revolutions a minute. Further particulars will be cheerfully furnished by the American Tool & Machine Co., of 109 Beach St., Boston, or upon application to their New York office, 220 Broadway.

Stocker Cooling Tower.

THE cooling tower, built by George J. Stocker, of St. Louis, has attracted a very considerable share of attention on account of the superior results obtained by it. A degree of pertection has been attained in the manufacture of this apparatus by the skilful arrangement of all its parts, which makes it to-day one of the best and most efficient water-cooling devices on the market.

Of the principles underlying its operation evaporation is by far the most important, although the cooling process is incidentally assisted by two other agencies, radiation and the contact of cold air.

The accompanying illustration shows the general arrangement of the apparatus. It consists of a tower-like structure (built of

wood, steel or bricks, as circumstances may require), encasing the cooling surfaces, which are made up of checker work or cross pieces of boards in horizontal layers, set at right angles to each other and provided, between their intersections, with upright oblique partitions.

The water, led to the top of the tower, trickles down over these surfaces in a thin film, which is broken up at each intersection of the boards and thus brought in the most intimate contact with the current of air that is forced by two fans through the tower.

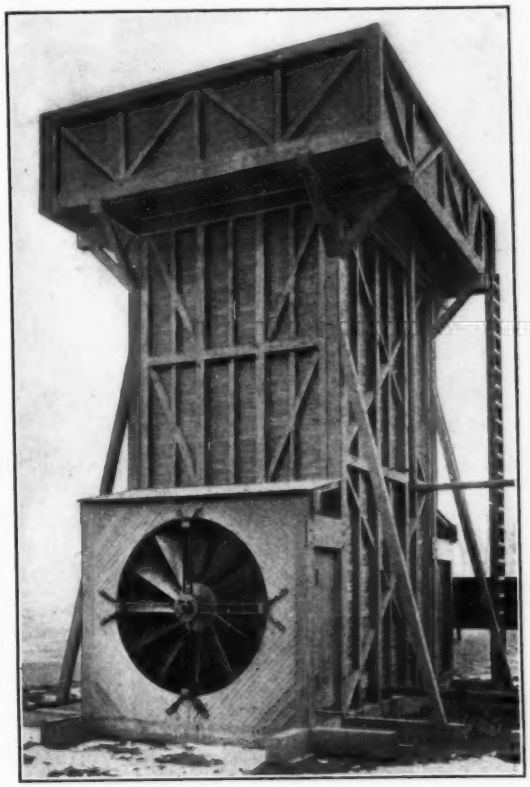
The fans, mounted on one shaft, may be driven by any convenient source of power, from a line shaft or by a small steam engine or electric motor, directly connected to the fan shaft.

The contrivance by which the water is distributed over the tower, and which was patented in March, 1902, consists of a system of funnel-shaped troughs of galvanized iron, so constructed and arranged that the water flows in an evenly proportioned way over the cooling surfaces, be the load great or small. The troughs are not liable to be clogged by sediments of impure water, as perforated pipes used in other towers always are, and can be cleaned easily.

A gallery, or drip hood, surrounds the tower, serving the double purpose of making the water distributor accessible to inspection and cleaning, and of preventing the water from splashing over the tower.

The superiority of the Stocker cooling tower lies first, in the improved construction of the cooling surface; second, in the unique method of distributing the water over the tower; third, in the application of two fans, instead of only one; and fourth, in the judicious selection of the materials from which all its working parts are built.

By this means the physical laws on which the cooling of liquids rests are brought into fullest play, and the water is consequently cooled to the lowest temperature compatible with the hygroscopic condition of the atmosphere, and at smaller cost per gallon than with any other cooling tower.



STOCKER COOLING TOWER.

Concerns who are users of large quantities of water for condensing and cooling purposes, cannot but be interested in the device, which saves from 95 to 98 per cent. of the water, by bringing it back to a physical condition and temperature where it can be used over and over again, and they may obtain full information about this cooling tower by applying to the manufacturer,

George J. Stocker, of 2833 South Kingshighway Boulevard, St. Louis

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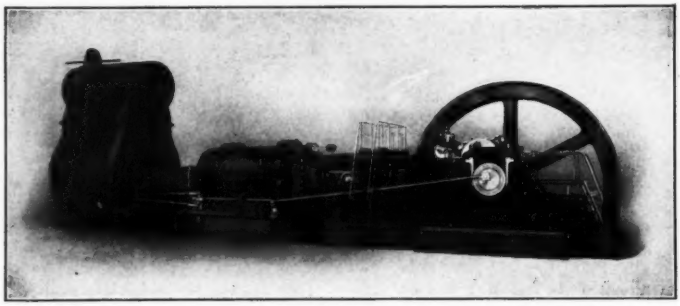
The Cockerill Gas Engine.

AMONG the first large gas engines to be put into commercial service were those of the Cockerill Company, at Seraing, Belgium, which were so successfully operated with gas from the blast furnaces there that they have been extensively adopted throughout Europe, and have been installed in units of from 200 to 3,000 horse power.

This engine is especially adapted for blast-furnace blowing-engine service and for heavy-duty electric light and power work.



COCKERILL GAS ENGINE.

It embodies valuable distinctive features, and is thoroughly representative of the most advanced practice in gas-engine construction. It is of the well-known four-cycle type, and is constructed with one, two or four cylinders—either single, tandem, twin or twin tandem.

The valve-gear is actuated by a second-motion shaft, driven by gearing from the crank shaft and running at half the speed of the latter. The second-motion shaft is located parallel to the axis of the engine, and carries the cams or eccentrics which operate the valves. The inlet valves are situated on the top and the outlet valves on the bottom of the cylinder, and are so designed as to secure easy accessibility.

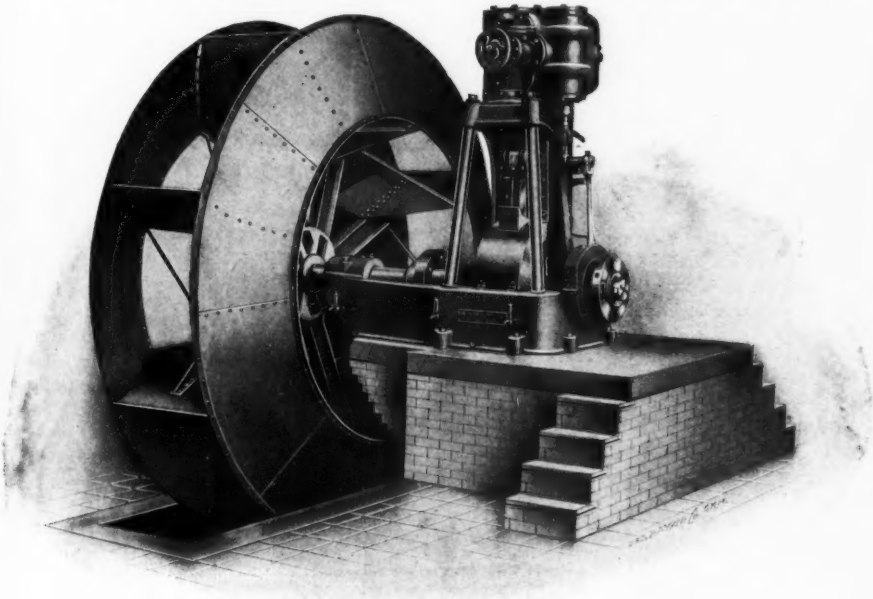
The regulation is effected by a governor which controls the admission of the mixture of gas and air in either of the following ways: First, by automatically cutting off or by throttling a constant mixture, either of which produces variable compression. Second, by varying the relative volumes of air and mixture, the latter always following the former, this method resulting in constant compression. In the latter case the mixing valve remains lifted during the entire suction stroke. The gas valve opens at a certain point during the suction stroke and remains open until near the end of the stroke. The point of opening is variable, and is determined by the governor at all times; the quantity of gas admitted is in exact proportion to the load of the engine, and the compression remains constant.

The engines are constructed with special regard to the heavy duty which they perform, and only first-class material is used. Provision is made for free expansion of the cylinder liners, and the cylinder heads can be easily removed in order to inspect the pistons without dismantling any part of the valve gear. Magneto-electric igniters of the most improved system are provided, and the starting of the engine is effected by compressed air.

A heat consumption of 10,000 British thermal units per hour per brake horse power, or a thermal efficiency of 25 per cent. at the rated capacity of the engine, is guaranteed by the sole American licensees, the Wellman-Seaver-Morgan Company, of Cleveland, who will be glad to furnish further details on application.

Mechanical-Draft Apparatus.

THE application of fans to induced-draft work has made necessary many changes from the established standards of fan builders, in order to avoid difficulties never met with in other lines of fan work, and even hardly anticipated in this. Most of the fans on the market to-day are built with two or three spiders, except in the very small sizes. A fan of the standard type usually has a bearing on each side of the fan, making the distance between bearings comparatively short. With this arrangement there is no deflection of the shaft, and the fan wheel is very smooth running. But when these fans have to be adapted to the handling of hot gases, it is positively necessary to keep the bearings removed from the path in which the gases travel, as they would otherwise become overheated. This necessitates either having an overhung wheel or placing one bearing outside of the inlet chamber built onto the side of the fan. Unless the bearings are placed very close to the center of the fan, the overhang will cause deflection, which will work the keys loose and most likely cause the fan wheel to strike the housing. The same is in a large measure true when the two bearings are far apart. Increasing the diameter of the shaft is not a relief, as by its own weight it will deflect. Then again, the intense heat within the housing causes it to expand, and as the steel frame work of the housing is outside and at a much lower temperature than the shell, the natural curvature, if any, is inward. Just how much this expansion will amount to can never be predetermined. Hence, the greatest of care in setting up will often prove of no value when the fan is put into operation, the deflections and expansions causing the wheel to strike on one or the other of the sides or at certain points.



A B C FAN WHEEL AND VERTICAL ENGINE.

These are matters for very serious consideration with any one who has had experience in this line of work, and the American Blower Company have devoted a great deal of time to the improvement of these details. In the wheels of their latest type of

construction, a number of which are in operation and giving entire satisfaction, the spider is made up of I beams, which have about three times the strength of a double set of tee arms as usually employed. In addition to this, every blade is braced with bar iron braces from the outer rim to the center, which completely overcomes any tendency to twisting. In the side of the fan housing is built a very deep cone which reaches in close to the hub. A special arm of very heavy construction is built on the cantilever principle to carry the inner bearing, which is water jacketed. This is placed at the very apex of the cone. The distance from the end of the apex to the end of the projecting shaft seldom exceeds a foot.

The illustration shows a fan wheel mounted on a shaft with a direct coupled engine erected on this form of construction. It is not always customary to make an extension of the base of the engine as here shown. In some cases an I-beam grillage is built into the brick foundation, the engine being set on top of the outer ends of these I beams and anchored down, which makes practically a complete unit of the entire outfit.

Two large units of the character shown in the illustration have been furnished the Wilkes-Barre & Wyoming Valley Traction Co., of Wilkes-Barre, Pa. These wheels are encased in a three-quarter steel plate housing, the wheels being 11 feet in diameter and driven by 12 by 10-inch vertical engines. They are intended to furnish induced draft in the power house in the above railway plant.

Further details will be furnished on request by the American Blower Company, of Detroit.

Fire Protection in a Department Store.

THE value of private fire apparatus for the protection of individual buildings and adjoining property was thoroughly demonstrated in the Baltimore and Toronto fires, and, in fact, the Baltimore Fire Department admits that many buildings on the immediate margin of the devastated tract were saved only by the effective work of private apparatus. These buildings were supplied with either stand pipes or pumps connected with wet-pipe interior sprinklers and dry-pipe sprinklers for protection from outside fires, storage tanks holding from 1,500 to 15,000 gallons being placed on the roofs. Besides saving the buildings in which they were located these equipments stopped the advance of the fire, and undoubtedly many more buildings would have been destroyed in the absence of their efficient service. The buildings and contents protected by private apparatus in Baltimore were valued at five million dollars and at Toronto the saving from private protection was similar in extent.

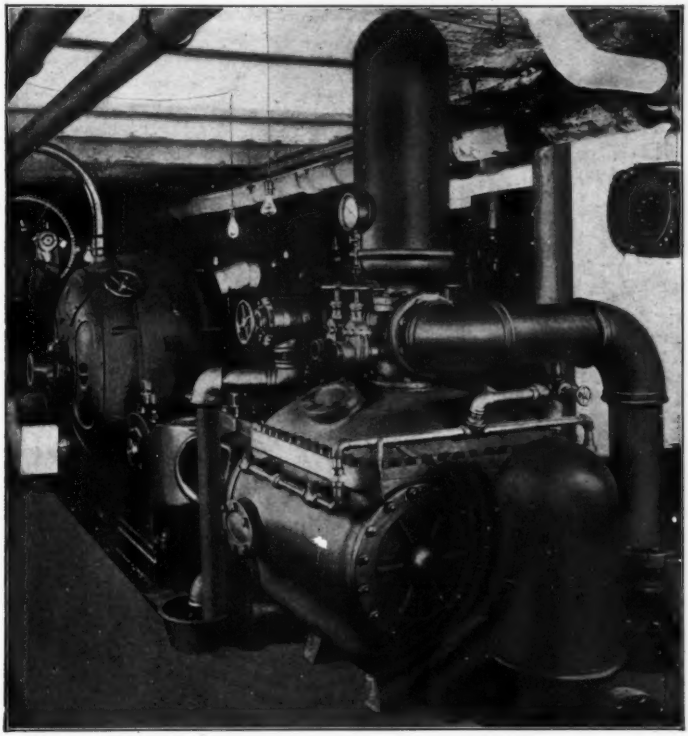
The fact that such apparatus is on the ground, in position and ready for action, averts the destruction of much property by both fire and water. A fire is usually well under way before the city fire companies can arrive, arrange their hose lines and make necessary couplings and connections. A drenching of the entire building is then often required, while a comparatively small amount of water would have put out the fire in the first place. The immediate availability of private fire apparatus gives it a great advantage over any other form. The fire insurance companies have recognized the decrease of fire risk in property containing private protection, and consequently are able to reduce premiums by such a percentage that the property owner is in a short time fully recompensed for the cost of the installation. The disastrous conflagrations of the past year have stimulated interest in the development of fire apparatus, and a very extended adoption of private equipment is to be expected.

A recent installation of considerable interest is shown in the accompanying illustration. It is located in one of the largest buildings of its class in the world, Marshall Field's immense department store, occupying an entire block in the busiest section of Chicago.

The outfit consists of a Laidlaw-Dunn-Gordon duplex underwriter pump connected by single-reduction gearing to a water-proof electric motor. The pump cylinders are eight inches in diameter by twelve inches stroke, having a theoretical capacity of 700 gallons per minute at 600 revolutions per minute against a water pressure of 140 pounds per square inch. The illustration gives a good general idea of the pump,

showing the special attachments and the large pressure and vacuum chambers required by the underwriters' specifications. The pump is thoroughly rust proof in all moving or wearing parts, insuring prompt and smooth running when occasion arises.

The motor, which was furnished by the Chicago Edison Co., is shunt wound for 220 revolutions per minute at 230 volts, and is enclosed, all connections being carried through pipes screwed into the frame, so that the apparatus may be flooded without affecting its action. The fields and armature coils are cooled by fans on the armature shaft, the ventilator intake and outlet being visible in the illustration. This combination has been designed to insure reliability and certainty of action under all conditions.



LAIDLAW-DUNN-GORDON PUMP WITH ELECTRIC DRIVE.

One of the important considerations affecting the selection of a device of this sort is the readiness with which electric power can be obtained and utilized; but there is hardly a building where a reliable supply of electric current cannot be cheaply and easily procured, and electric driving entails no stand-by or maintenance expense as with steam apparatus.

Further particulars regarding this interesting installation may be obtained from the International Steam Pump Co., of 114-118 Liberty Street, New York.

Large Back-Pressure Valve.

WHAT is probably the largest valve of its type that was ever constructed has recently been made by the G. M. Davis Regulator Company, of Chicago, and is to be installed at the Donora Works of the Carnegie Steel Company, Donora, Pa.

It is for a 46-inch pipe and weighs complete 7,900 pounds. It will be placed at the end of an exhaust line in a vertical position about 18 feet above the level of the floor. This exhaust line, into which five large condensing blowing engines exhaust, is approximately 215 feet in length and is gradually increased in diameter at different intervals from 28 inches at the beginning to 46 inches at the end. The low-pressure cylinders of the engines work under vacuum, and the object of the valve is to automatically provide a free relief to the atmosphere, if for any reason the vacuum is lost. If such provision were not made there would be danger of damaging the engines by the accumulation of back pressure.

DAVIS BACK-PRESSURE VALVE.

The valve body is of cast iron. The inner disc, which is guided at the top and bottom by spiders cast in the body, is of cast steel. It is faced with babbitt metal and seats on a cast-iron seat. A 2½-inch cold-rolled steel shaft runs horizontally through the body of the valve on which there are two cut steel pinions, one of which is inside the body and meshes with a cast-steel rack on the disc stem. The other is at the end of the shaft just outside the body and meshes with a rack which leads to the hydraulic cylinder, and also with the segment to which is attached the lever carrying a cast-iron counterweight of 150 pounds. The valve is provided with this counterweight to act as a safeguard by throwing the disc wide open as soon as pressure accumulates under it, thus preventing any injury to the seat by pounding. On account of the unusual size of the valve and the weight of the disc, it was found not practical to make the valve wholly automatic. It opens automatically, but the closing is controlled by hydraulic pressure, a hydraulic cylinder 5 inches in diameter being connected at the top and bottom by a ½-inch pipe on which there is a four-way cock. This cylinder is under a constant pressure of 25 pounds, and when the valve is closed the cock is set to turn the pressure into the lower end of the cylinder. When it is desired to close the valve after it has been thrown open, this cock is set to turn the pressure into the upper end of the cylinder. A gradual closing is thus effected and the cock is again set at normal position.

With the order for this valve was one for a 36-inch valve to be installed at the same works of the Carnegie Steel Company. The weight of the latter valve complete is 4,900 pounds.

Further particulars regarding these valves may be obtained from the G. M. Davis Regulator Co., of 141 Milwaukee Avenue, Chicago.

Feed-Pump Controller.

ONE of the most vital parts of a steam-generating plant is the feed pump, and it is of the greatest importance that this should operate properly and keep the boiler supplied with the right amount of water. It was formerly the custom to regulate the throttle valve of the feed pump by hand, but modern conditions demand a more efficient method, which is supplied by the apparatus shown in the illustration, Mullin's automatic controller for boiler feed pumps.

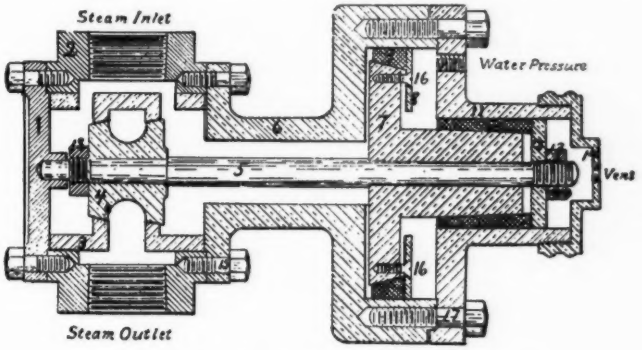
This is a governing valve controlled by the relative pressure of the steam and the water. By putting the steam pressure on one face and the water pressure on the reduced area of the opposite face, a water pressure in excess of the steam pressure is maintained, without regard to fluctuations of the steam. When the steam pressure falls, the controller, by reducing the supply of steam to the pump, reduces the feed-water pressure; and when the boiler pressure rises, there is such an additional steam delivery to the pump as will afford the

requisite increase of the water pressure, thus automatically maintaining the water and steam pressures in proper ratio to each other.

Because of the large area of the piston of the controller exposed to pressure, it is extremely sensitive and will respond to the slightest variations of pressure, delivering more water to the boilers when the steam pressure is high and less when it is low, which not only holds the water uniform, but also tends to keep the steam pressure uniform, thus saving fuel that is wasted in pumping too fast and flooding the boilers when the fires are low.

No relief valve is necessary where the controller is used, as the pump will stop when the proper pressure has been reached and will start again automatically when required, so saving excessive wear on the pump incident to discharging through the relief valve at high restrained pressures. It is not necessary to throttle the pump every time a feed valve is changed, as after that valve is opened wide when the plant is started up, it is so left while the plant is running. In this way the hand regulation of the feed valves on the boilers is reduced 85 per cent. and the time and trouble of traveling from feed valve to pump many times a day is saved. In a battery of boilers this is particularly desirable during the cleaning of fires, as the hand regulation of the feed valves does not affect the feed of those already set, and the feed can be taken all off, without going near the pump.

The Mullin automatic feed-pump controller is constructed of good material and is supplied in pipe sizes from one-half inch up. The valve seats are of phosphor bronze and will not cut out by steam action. This controller has no arms, weights, springs, floats or any other contrivances to get out of order and give trouble, and further information concerning it and its operation may be obtained from the manufacturers, The Federal Valve Co., of Seattle, Wash.



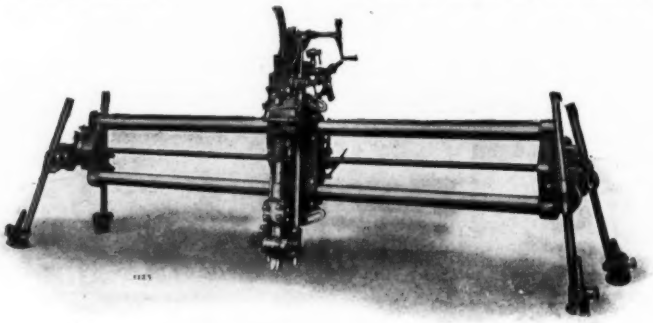
MULLIN'S AUTOMATIC CONTROLLER FOR FEED PUMPS.

Ingersoll-Sergeant "Broncho" Channeler.

IN the quarry processes of to-day, there is a wide field of usefulness for a rock-cutting machine intermediate in its functions between the heavy track channeling machine and the machine drill as applied in the "plug and feather" method of breaking rock. In the development of new quarrying properties, also, it is advisable to prove up the value of the deposit before heavy investments are made. Yet the slow method of hand clearing and prospecting cannot be tolerated. In developed quarries, too, it is often necessary to channel material which has a sharp dip or incline, and there a heavy track channeler is not practicable. In the lighter work of the quarry, such as cutting stumps and keyblocks, enlarging the walls and working in confined and uneven places, a light portable machine is always useful and effective.

To meet just such conditions as these the Ingersoll-Sergeant Drill Company, of New York, has placed on the market its latest

type of machine channeler which has been given the distinctive name of "Broncho," perhaps because of its tough, rough and ready character, its tireless strength and its faculty of standing up to work under the most severe conditions of service. The appearance of the machine is clearly shown in the accompanying illustration, which also brings out distinctly some of the more important details. Those familiar with the old-fashioned quarry bar or bar channeler will doubtless see some resemblance between them and this new machine.



INGERSOLL-SERGEANT "BRONCHO" CHANNELER.

But while the "Broncho" is an outgrowth and development of the old bar channeler, its distinctive features of design, operation and construction mark it as an entirely new type of machinery.

The frame of the "Broncho" is a structure combining great simplicity and strength. The bars are of heavy pipe rigidly secured in sturdy end castings. Between the bars the heavy steel traveling screw is firmly mounted. The end castings of the frame are swivelled in heavy end pieces, to which are joined the connections. Cone clamp effect is secured at all these joints, and the result is a structure of great flexibility and almost universal adjustment, yet of the utmost rigidity when pressure is applied.

The channeling machine proper is in no sense a rock drill, but a heavy cutting engine designed to secure great strength and effectiveness. The cylinder has a diameter of 3½ inches and a full stroke of 6 inches, variable down to a minimum of two inches. For starting cuts, working through soft spots, and cutting across splits or seams, where the full blow is not desirable, a most valuable feature is provided in a cushioning device whereby the blow may be varied from the merest tap to a blow of full power. A feature exclusively used by the Ingersoll-Sergeant Drill Company is an extended tail rod, being a back piston passing through the rear head.

This is the only channeler which will both cut an open channel and drill a round hole, at any angle from horizontal to vertical. The engine has two rotations; one around the axis of the frame, the other around an axis at right angles to this one. While the best results with this machine are secured by the use of high-pressure steam or air, the valve motion is such as to secure, with low pressure and wet steam, results superior to those to be obtained with machines of older types under even the best conditions.

The net weight of the "Broncho" channeler is about 3,000 pounds. It is designed to make a cut of 10 feet 6 inches long to a depth of 12 feet. The capacity varies, of course, with the pressure used and the material cut. Its best work is done with a pressure of about 100 pounds at the throttle and cuts 7 to 10 feet deep. It uses about 175 cubic feet of free air per minute, or requires a boiler of 20 to 25 horse power.

The "Broncho" channeler is characterized by the three qualities so distinctive of Ingersoll-Sergeant machinery: economy, reliability and simplicity. In the field it is sure to meet with the cordial approval of all practical quarry men, and further information will be supplied by the Ingersoll-Sergeant Drill Co., 26 Cortlandt St., New York.

NEWS SUPPLEMENT

The Engineering Magazine—January, 1905

Coming Society Meetings.

AMERICAN ELECTROCHEMICAL SOCIETY. Sec.: S. S. Stadler, 39 S. 10th St., Philadelphia. Next meeting, April 25-27, at Boston.

AMERICAN FOREST CONGRESS. Sec.: Wm. L. Hall, Atlantic Building, Washington, D. C. Meeting under the auspices of the American Forestry Association, Jan. 2 to 6, at Washington.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Sec.: Ralph W. Pope, 95 Liberty St., New York. Meetings on fourth Friday of each month at Carnegie Hall, 154 W. 57th St., New York. Subject for Jan. 27: Central Stations.

AMERICAN INSTITUTE, POLYTECHNIC SECTION. Sec.: George Whitefield, Jr., 19 W. 44th St., New York. Meetings on first and third Tuesdays of each month, from October to May, inclusive.

AMERICAN RAILWAY ASSOCIATION. Sec.: W. F. Allen, 24 Park Place, New York. Next meeting, April 5, at New York.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Sec.: J. W. Taylor, 658 Rookery, Chicago. Meeting, June 14 to 16, at Oriental Hotel, Manhattan Beach, New York.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Sec.: C. W. Hunt, 220 W. 57th St., New York. Regular meetings, first and third Wednesdays of each month, except July and August.

BOSTON SOCIETY OF CIVIL ENGINEERS. Sec.: S. E. Tinkham, 715 Tremont Temple. Regular meetings on third Wednesday of each month, except July and August.

BROOKLYN ENGINEERS' CLUB. Sec.: J. Strachan, 191 Montague St. Regular meetings on second Thursday of each month.

CANADIAN RAILWAY CLUB. Sec.: W. H. Rosevear, Jr., Montreal. Regular meetings on first Tuesday of each month, except June, July and August.

CANADIAN SOCIETY OF CIVIL ENGINEERS. Sec.: Prof. C. H. McLeod, 877 Dorchester St., Montreal. The General Section and the Electrical, Mechanical and Mining Sections meet on different Thursdays, from October to May.

CENTRAL RAILWAY CLUB. Sec.: Harry D. Vought, 62 Liberty St., New York. Regular meetings on second Friday of January, March, May, September and November, Hotel Iroquois, Buffalo.

CHICAGO ELECTRICAL ASSOCIATION. Sec.: W. B. Hale, Monadnock Building. Regular meetings on first and third Fridays of each month, from October to May.

CIVIL ENGINEERS' CLUB OF CLEVELAND. Sec.: Joseph C. Beardsley, 689 The Arcade. Regular meetings on second and fourth Tuesdays of each month.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL. Sec.: G. S. Edmonstone. Regular meetings on second Monday of each month.

ENGINEERING ASSOCIATION OF THE SOUTH. Sec.: Robt. L. Lund, 2102 Hayes St., Nashville, Tenn. Regular meetings on second Thursday of each month at the Berry Block.

ENGINEERS' CLUB OF CHICAGO. Sec.: B. W. Thurtell, 1223 New York Life Building. Regular meetings on first and third Tuesdays of each month.

ENGINEERS' CLUB OF CINCINNATI. Sec.: C. H. Meeds, P. O. Box 333. Regular meeting on third Thursday of each month, except July and August.

ENGINEERS' CLUB OF COLUMBUS (OHIO). Sec. H. M. Gates, 5½ West Broad St. Regular meetings on third Saturday of April, May, June and September, and on first and third Saturdays from October to March, inclusive.

ENGINEERS' CLUB OF MINNEAPOLIS. Sec.: Jas. B. Gilman, American Bridge Co. Regular meetings on third Monday of each month, except July and August.

ENGINEERS' CLUB OF PHILADELPHIA. Sec.: Walter Loring Webb, 1122 Girard St. Regular meetings on first and third Saturdays of each month, except July and August.

ENGINEERS' CLUB OF ST. LOUIS. Sec.: R. H. Fernald, 3817 Olive St. Regular meetings on first and third Wednesdays of each month.

ENGINEERS' SOCIETY OF WESTERN NEW YORK. Sec.: H. B. Alverson, 533 Ellicott Square, Buffalo. Regular meetings on first Tuesday of each month.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. Sec.: Chas. W. Ridinger, 410 Penn Ave., Pittsburg. Regular meetings on third Tuesday of each month.

FRANKLIN INSTITUTE. Sec.: Dr. Wm. H. Wahl, 15 South 7th St., Philadelphia. General meetings on third Wednesday of each month, except July and August. General section meetings every Thursday.

HONOLULU ENGINEERING ASSOCIATION. Sec.: G. F. Bush, Honolulu, Hawaii.

INTERNATIONAL RAILWAY CONGRESS. General Sec.: Louis Weissenbruch, Belgian State Railways, Brussels, Belgium. Sec. of American Section: W. F. Allen, 24 Park Place, New York. Seventh session, May 3-15, 1905, at Washington.

IOWA RAILWAY CLUB. Sec.: A. T. Woodruff, Des Moines, Iowa. Regular meetings on second Monday of each month.

LOUISIANA ENGINEERING SOCIETY. Sec.: G. W. Lawes, 806 Gravier St., New Orleans. Regular meetings on second Monday of each month.

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—*The American Architect,* which has been published in Boston since 1875, has been purchased by a New York corporation, at the head of which is Mr. F. P. Burt, lately manager of the *Engineering News,* but Mr. William Rotch Ware continues to be associated with the editorial management. The main office of *The American Architect* is now in the Times Building, Broadway and 42d St., New York.

—The Illinois Steel Company, through their Cement Department, are distributing two attractive booklets, neatly bound in flexible cloth. One is entitled, "Facing and Finishing Exposed Concrete Surfaces," and is reprinted from "Reinforced Concrete," by A. W. Buel and C. S. Hill. The other contains the report of the Committee of the American Society for Testing Materials on "Standard Specifications for Cement."

—The Lawrence Pump and Engine Co., of Lawrence, Mass., has recently been incorporated to manufacture a complete line of improved centrifugal pumps. Mr. H. L. Mellor, who has been engaged for several years in designing and building this class of machinery, is general manager of the company.

—A. Leschen & Sons Rope Co., of St. Louis, received three grand prizes, the highest awards, for their exhibits at the St. Louis Exposition, one for wire rope, one for wire-rope tramways, and one for conveying and transmission haulage outfits.

—The Reeves Engine Company have opened an office at 1612 Monadnock Building, Chicago, which will be in charge of Mr. Joseph B. Hall.

—J. A. Fay & Egan Co., of Cincinnati, the manufacturers of woodworking machinery, announce the opening of their new offices in Chicago, in the Railway Exchange Building, suite No. 751. The offices will be in charge of Mr. Everett S. Kiger, and visitors to Chicago who are interested in woodworking machinery are cordially invited to make these offices their headquarters. J. A. Fay & Egan Co. will hereafter do all business in this territory direct.

—The Abner Doble Company, of San Francisco, have been awarded a grand prize for their exhibit of a tangential water wheel at the St. Louis Exposition. This wheel developed 170 horse-power at a speed of 700 revolutions per minute with a water pressure of 500 pounds per square inch, equivalent to a hydraulic head of nearly 700 feet. It was direct connected to a 100-kilowatt Crocker-Wheeler railway generator, which was one of the units of the Intramural power plant.

—The Triangle Protractor Company, of Worcester, Mass., has recently brought out a 45° celluloid triangle, with a sliding bar protractor which can be read to ten minutes. It is reversible and invertible.

—The A. S. Cameron Steam Pump Works, of East 23d Street, New York, had a display in machinery Hall, at the St. Louis Exposition, which was awarded the gold medal and commended by all good judges of pumps who inspected the exhibit. Besides a number of regular patterns on exhibition, there was a Cameron fuel-oil pump and heater, for use in connection with an oil-burning system, the distinctive features being the by-pass valves and piping, to avoid, when desired, pumping oil through the heater. This is important, as exhaust steam may be utilized to heat the oil to any degree necessary by using the by-pass in connection with it. There were also an oil-line pump for handling crude oil or a fine petroleum, a vertical boiler feed pump, a vertical deep-well engine, several contractors' differential pumps and the well-known Cameron vertical plunger and piston sinking pumps for mine service. Another type shown was a large pot-valve pump, designed for mine station pumping and heavy service. This is of a very modern type, and is especially noted for its employment in mines which are subject to floods from surface drainages or workings, or from cutting into subterranean bodies of water, which necessarily must be pumped out in short order, and also where the water is strongly impregnated with sulphur and the use of the ordinary iron pump prohibited. A number of their pumps were also placed in actual service at the Exposition, so forming a working exhibit and practically demonstrating their many good points. The works and general offices of The A. S. Cameron Steam Pump Works are in New York City, but they are directly represented in the principal cities in this country and foreign lands, having over sixty branches or agencies at home and abroad. They have recently published a miniature catalogue of novel and

attractive design and their new and complete catalogue is ready for distribution.

—The G. Drouve Company, of Bridgeport, Conn., manufacturers of cornices, skylights, finials, etc., have issued their annual calendar, which is particularly suitable for offices, the figures being large and clear and not interfered with by any advertising matter. The top half of the calendar is devoted to a representation of the wares that they manufacture. A copy of this calendar will be sent upon request.

—The F. W. Foster Mfg. Co., the makers of shaking grates, float valves and other steam and water specialties, have been compelled, owing to their increased business, to move to more commodious quarters, and are now located in their new office and salesrooms, at 99 Haverhill Street, Boston.

—The Department of Mechanics of the University of Arizona has started an indexed catalogue file, and requests catalogues of steam and gas engines, electrodynamic, hydraulic, mining and milling machinery, fittings and supplies. They will be used for purposes of instruction, as will also a collection that is being formed of mechanical devices, machine parts, fittings, and samples of supplies and materials of machine construction. Any contribution to the collection will be very welcome. Address Prof. E. M. Blake, University of Arizona, Tucson, Ariz.

—The American Society of Refrigerating Engineers was organized on December 5, at 12 W. 31st Street, with the following officers: President, John E. Starr; vice-presidents, P. De C. Ball and H. B. Roelker; treasurer, W. C. Reid; secretary, Wm. H. Ross, Produce Exchange Annex, New York; directors, W. E. Parsons, Henry Torrance, Jr., E. L. Phillips, D. S. Jacobus, L. H. Jenks, Louis Block, Edgar Penney, W. T. Robinson and Thomas Shipley.

—The Erie Railroad, owing to its geographical situation and the great natural resources of the region it traverses, offers peculiar advantages to manufacturers for the location of their plants. Running, as it does, from New York to Chicago through the States of New York, New Jersey, Pennsylvania, Ohio, Indiana and Illinois, and traversing great coal, oil and natural gas fields on its way, it enables manufacturers to easily obtain supplies of raw material, and at the same time gives them direct access to the principal markets of the country. A great many industries have recently been located along this railroad, and manufacturers who contemplate the establishment of new plants will find it to their advantage to communicate with Luis Jackson, Industrial Commissioner, Erie Railroad Company, 21 Cortlandt Street, New York.

—The Crocker-Wheeler Company, of Ampere, N. J., through its Pacific Coast managers, the Abner Doble Company, of San Francisco, has secured a contract from the California Gas and Electric Corporation, of San Francisco, for three 4,000-kilowatt, 3-phase, 13,200-volt, 25-cycle, revolving-field alternators, to be driven at a speed of 83 revolutions per minute by 6,000 horsepower gas engines built by the Snow Engine Company. These generators are the largest in capacity in the world driven by gas engines, and will furnish power for operating all the street railways in San Francisco and vicinity. This important sale by a company which has been building alternating-current machinery only a few months is a cause for congratulation. It is due in part to the fact, as announced several months ago, that the Crocker-Wheeler Company is the American licensee of Brown, Boveri & Cie, the celebrated Swiss electrical engineers. But the reputation for excellence which the Crocker-Wheeler Company has built up during the past sixteen years of manufacture of direct-current apparatus has had much to do with the result.

—A memorable incident of the morning following the close of the St. Louis Exposition was the formal shut-down and inspection of the 600 horse-power Westinghouse steam-turbine generating unit in the Palace of Machinery after a continuous run of over 3,962 hours, a performance which has had no parallel in steam-turbine history. This machine was started on its long run at 9:20 o'clock on the morning of Monday, June 20, shortly after its installation at the Fair, and was stopped at 11:32 o'clock on the morning of Friday, December 2. During the five and a half months that the unit was in operation it supplied current for light and power throughout the Westinghouse exhibits in the Palaces of Machinery, Electricity, and Transportation. Charles F. Foster, chief operating engineer of the Exposi-

tion; H. M. Holman, supervising engineer at the Government Exposition gas-engines tests, formerly president of the St. Louis Board of Public Works, and a number of Westinghouse representatives, including Wallace Franklin, of Detroit; C. C. Chappelle, of Chicago, and W. K. Dunlap, managing director of the Westinghouse exhibits, were present when the engine was stopped. It was found to be in perfect condition, and there were no signs of wear, the bearings still retaining the tool marks as they had come from the shops. There have been at least two instances on record in America in which piston engines have been run continuously for about the same length of time as that of the record run of the Westinghouse turbine. The remarkable feature of the turbine run, of course, was the maintenance under load of a speed of 3,600 revolutions a minute for such a long period. From 8:30 o'clock in the morning to 10:30 o'clock in the evening, the load carried throughout the Exposition varied from 25 per cent. underload to 25 per cent. overload. The total number of revolutions almost touched the billion mark—855,792,000.

—One of the greatest, and, in many respects, the most spectacular water-supply system ever undertaken is that for the Coolgardie district, in Western Australia. Nearly six million gallons per day are taken from the Helena River, near the coast, and forced through a 300-mile steel pipe line across waterless deserts by eight pumping stations, which are equipped with triple-expansion, high-duty Worthington pumping engines. The contractors for this machinery were Messrs. James Simpson & Co., Limited, of London.

—The Northern Electrical Manufacturing Co., of Madison, Wis., recently received an order for three 150-kilowatt, slow-speed generators from the Tennessee Coal, Iron & Railroad Co., of Birmingham, Ala. This order was received through J. B. McClary & Co., the Birmingham representatives of the Northern Electrical Manufacturing Co. The Lee Paper Company, of Vicksburg, Mich., has lately ordered a 200-kilowatt Northern generator for the equipment of its new mill. This is the most recent in a long series of sales of Northern apparatus for paper-mill work, the most prominent installation being the plant of the Consolidated Water Power & Paper Company, of Grand Rapids, Wis., in which are operated a quantity of Northern motors of all sizes, as well as two 300-kilowatt direct-current generators. The Consolidated Water Power & Paper Co.'s plant contains, among other motors, two large single-voltage variable-speed motors, operating from the mill power circuit and giving speed variations from 300 to 500 revolutions per minute, corresponding with machine speeds of 50 to 500 feet per minute.

—The Rhode Island College of Agriculture and Mechanic Arts has established a course in highway engineering, full particulars of which may be had by addressing President Kenyon L. Butterfield, Kingston, R. I.

—The Pennsylvania Railroad System has received a special commemorative grand prize from the Louisiana Purchase Exposition "for its original series of scientific investigations of locomotive performance conducted there, the methods and results of which are a permanent contribution to the advancement of engineering knowledge." The Pennsylvania Railroad has also received seven other grand prizes and three gold medals for its large and fine exhibits, and gold medals were awarded to each of the collaborators in connection with the preparation of the exhibits and the testing plant.

—The Wager Computing Scale Company, of Philadelphia, have brought out a convenient and ingenious timber scale for computing the strength of wooden beams, which will be a great time saver for anyone interested in the design of wooden structures.

—The Columbia University fire-testing station is equipped with buildings suitable for testing floors, partitions, columns, doors, windows, and all varieties of building construction in full-sized units. A complete laboratory equipment is available for making fire and other physical tests upon small samples. A report of a fire, load and water test, made at this testing station, upon a Kahn system, 15-foot-span, reinforced-concrete floor, constructed by the Trussed Concrete-Steel Company, of New York, has recently been issued. This test was conducted by Ira H. Woolson, E. M., adjunct professor of mechanical engineering at Columbia University, in co-operation with the New York City Building Bureaus.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Prospector's Drills.

"The Diamond Drill and Its Work" is the title of an eighty-page illustrated pamphlet, which should hold a place in the reference library of every engineer and manager who is either directly or indirectly concerned with testing the strata of the earth. In its pages are embodied the results of over thirty years of expert and practical experience in all parts of the world; it is arranged logically throughout, and is carefully indexed; it deals only with practical results, based upon actual performances of the machine; it illustrates all the standard types, from the hand power drill to the highest motive power machines; and as a whole it constitutes a serviceable, suggestive and valuable handbook of the subject. American Diamond Rock Drill Co., Box 1442, New York, U. S. A.

Rock Drill Tests.

In response to many inquiries for "exact details" as to the rock drill tests held at the City and Suburban gold mines, Johannesburg, South Africa, The Rand Drill Co., 128 Broadway, New York, have issued an illustrated folder presenting the complete table of each run as published in the Journal of the Mechanical Engineers Association of the Witwatersrand, together with the report by Mr. J. D. Carper, M. E. Free upon request.

Gravity Planes.

An illustrated eight-page pamphlet giving a detailed description of the celebrated "Stine" gravity planes, which in recent years have been so successfully adopted throughout the mining regions of the United States. Striking testimonials from users are presented, and the detailed description of the mechanism will be of interest and value to mining engineers and mine managers who are concerned with the problems of transporting materials by gravity. S. B. Stine & Son, Osceola Mills, Pa., U. S. A.

Cranes.

Illustrated catalogue and general description of jib cranes, swing cranes, pillar cranes, car cranes, locomotive cranes, traveling cranes, and other styles, in capacities ranging from 5 tons to 150 tons. Most of these cranes are driven electrically, but some are worked by hand or by hydraulic power, and many of them are shown in operation at prominent engineering and manufacturing works. 9 by 7¼ in.; pp. 48. William Sellers & Co., Incorporated, Philadelphia.

Booklet No. 19, illustrating and describing electric traveling cranes in many sizes and for various purposes, jib cranes of different types, locomotive cranes, air hoists, electric hoists, and other kinds of cranes and hoisting machinery. 3½ by 5½ in.; pp. 28. Northern Engineering Works, Detroit.

Automobile.

Catalogue, giving a very well illustrated description of the Adams-Farwell motor car and the history of its development. This automobile has a convertible Brougham body, a revolving-cylinder, air-cooled motor and many other novel and attractive features. 6 by 9½ in.; pp. 32. The Adams Company, Dubuque, Iowa.

Arc Lamps.

Bulletins Nos. 7030, 7035 and 7,040 devoted, respectively, to multiple-series and constant-current arc lamps for direct-current circuits; multiple constant-potential alternating-current arc lamps; and multiple constant-potential direct-current arc lamps. 10¾ by 7¾ in. Western Electric Company, Chicago.

Boring Mills.

Catalogue, of artistic design, with descriptions and handsome illustrations of vertical and horizontal boring mills, turret lathes and tool grinder. 9½ by 7¾ in.; pp. 28. Gisholt Machine Company, Madison, Wis.

Cement Machinery.

Large pamphlet, entitled "The Construction of a Modern Cement Plant," containing half-tone illustrations, an account of Portland and other kinds of cement, descriptions of many large cement manufacturing plants, useful information about cement, and a review of the Dodge American system of power transmission by Manila rope, which is extensively used in cement plants. 12 by 9¼ in.; pp. 75. Dodge Manufacturing Co., Mishawaka, Ind.

Controller.

Bulletin No. 1, giving an illustrated description of the "Rheocrat," a controller for electric motors, particularly those driving machine tools, which will give uniform gradations of speed over a wide range, consumes very little power and can be readily adapted to plants already in operation. 9 by 6 in.; pp. 4. American Electric & Controller Company, 12 Dey St., New York.

Cooper Hewitt Lamps.

Bulletin No. 5, containing illustrated descriptions of the Cooper Hewitt mercury vapor lamp, which consists of a vacuum tube containing a little metallic mercury, which becomes vaporized on the passage of an electric current and emits an intense highly efficient light. Many applications of this lamp are shown, particularly to all kinds of photographic work, for which it is admirably adapted. 9 by 6 in.; pp. 26. Cooper Hewitt Electric Co., 220 West 29th St., New York.

Drawing Pens.

Circular, with illustrations, descriptions and prices of an improved fountain ruling pen and a "universal" dotting pen. 9 by 5¾ in.; pp. 2. Kolesch & Co., 138 Fulton St., New York.

Electric Apparatus.

Bulletins, flyers and other publications, containing illustrated descriptions of transformers for thawing out pipes, attachments for circuit breakers, continuous-current railway switchboards, curve-drawing instruments for alternating-current circuits, modern long-distance electrical transmissions, Edison miniature incandescent lamps, "Noblac" heat-resisting enclosing globes for arc lamps and other electric apparatus and their auxiliaries. General Electric Co., Schenectady, N. Y.

Electric Machinery.

Pamphlet, showing the salerooms, repair department, testing department and other views of the Guarantee Electric Co., with short descriptions of their business in second-hand electric apparatus, which they guarantee for one year. 7 by 10¾ in.; pp. 14. Guarantee Electric Co., Chicago.

Filtration.

Catalogue, containing descriptions and illustrations of water filters of many different types and for all kinds of service, from dwelling houses to the largest waterworks systems, with views of some notable filtration installations, list of municipal filter plants, and testimonials. 6 by 9¼ in.; pp. 48. The New York Continental Jewell Filtration Co., 15 Broad St., New York.

Gas Producers.

Catalogue B, containing descriptions and illustrations of automobile gas producers, suction gas producers, and water-bottom gas producers for making gas for gas engines and furnace and heating work from coal and many other kinds of fuel. 9 by 6 in.; pp. 17. Wile Power Gas Co., Rochester, N. Y.

Magnetic Separators.

Pamphlet containing an account of the treatment of pyritic zinc ores, and an illustrated description of the Cleveland-Knowles electromagnetic separator and its method of operation in separating the iron minerals of ores from the other constituents. 9 by 6 in.; pp. 18. United Iron Works Co., Springfield, Mo.

Mechanical Stokers.

Pamphlet containing handsome illustrations and descriptions of the Roney mechanical stoker and its details, with diagrams showing the uniformity of steam pressure secured by its use, and views of some of the great power stations where it is installed. Boilers with an aggregate capacity of one million horse power have been equipped with this stoker. 6¾ by 9 in.; pp. 62. The Westinghouse Machine Company, East Pittsburg. Pa.

Packing.

Catalogue, with half-tone illustrations and descriptions of the "Kantblo" plastic metallic packing and some of its applications, together with many testimonials from users. This packing can be used to advantage for piston rods, steam hammers, air compressors, locomotive air pumps and throttle stems, stop valves, Corliss valves and valve stems and anywhere that steam or compressed air is used. 5½ by 8½ in.; pp. 46. Plastic Metallic Packing Co., Pittsburg.

Rock Drills.

Catalogue, containing descriptions, half-tone illustrations and line cuts of rock drills of various sizes, for use with compressed air or steam, drill mountings and their details, with useful tables and information. 9 by 6 in.; pp.32. Also, circulars with illustrated descriptions of these rock drills, and testimonials from users. Wood Drill Works, Paterson, N. J.

Rolling-Mill Machinery.

Large, cloth-bound catalogue, containing descriptions and half-tone illustrations of rolls, roll turning lathes, shears, punches, rail and angle straighteners, hot and cold metal saws, hydraulic accumulators, intensifiers and cranes, grinding mills, squeezers, ingot cars, tube-works machinery, and all kinds of rolling mills and rolling-mill machinery. 8½ by 10 in.; pp. 205. United Engineering and Foundry Company, Pittsburg.

Spiral Pipe.

Catalogue, bound in flexible cloth, containing descriptions, illustrations and price list of Taylor's spiral riveted pipe for water, steam, compressed air and other purposes, and supplies for hydraulic and exhaust steam piping, with views of long-distance pipe lines for water powers and of other installations and also useful data and tables of hydraulics. 8 by 4 in.; pp. 56. American Spiral Pipe Works, Chicago.

Thawing Outfit.

Bulletin containing description and illustrations of an outfit for thawing frozen water pipes by means of an electric current, consisting of a transformer, a heat indicator, a choke coil and connections. 8½ by 6 in.; pp. 4. Pittsburgh Transformer Company, Pittsburgh.

Twist Drills.

Booklet, containing illustrations, descriptions and prices of reamers, drill chucks, sockets, and, particularly, of twist drills of many styles and sizes. 6 by 3½ in.; pp. 20. The Standard Tool Co., Cleveland, O.

Valves.

Catalogue, containing illustrations, descriptions and prices of the Hancock globe, angle, 60° and cross valves and their parts. These valves are made screwed and flanged in sizes up to three inches, are equipped with tee handles, and have various other valuable features. 9 by 6 in.; pp. 23. The Hancock Inspirator Co., 85-87-89 Liberty St., New York.

Watchman's Clocks.

Pamphlet, containing illustrated descriptions of the Howard electric watchman's clock system, the clock and regulator, the record dial, and other apparatus, together with a long list of users. 8 by 4 in.; pp. 32. The E. Howard Clock Company, 401 Washington St., Boston.

IMPROVED MACHINERY

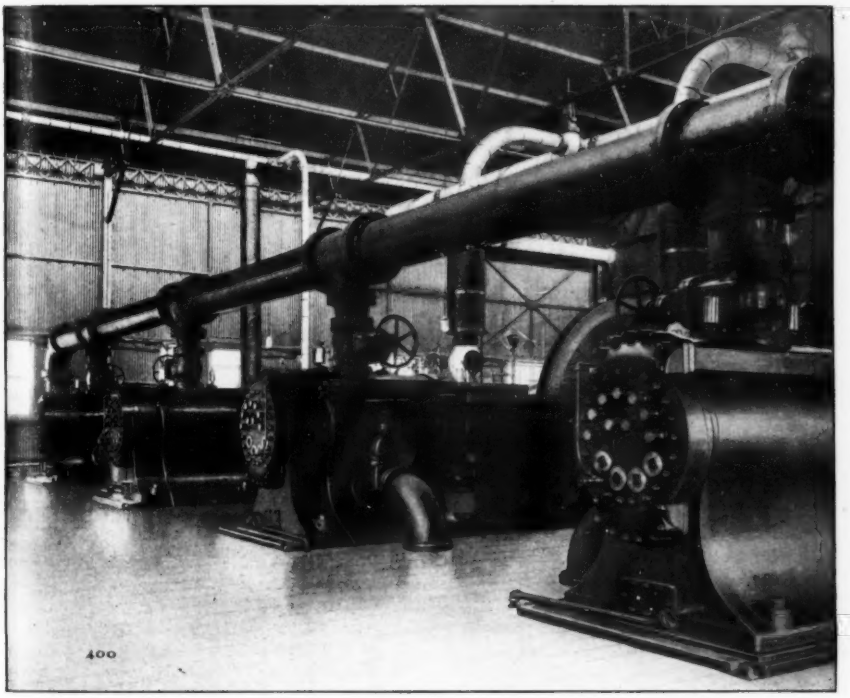
New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

A New Gas Compressor Plant.

A NEW and very interesting piece of engineering work is the gas compressor plant recently completed at Hundred, West Virginia, by the United States Steel Corporation, for the purpose of regulating the pressure and supply of natural gas, and thereby avoiding the wholesale wastes which heretofore have been common throughout all the regions where natural gas has been found.

The great steel works at Homestead, Duquesne, and Bessemer, consume about 65,000,000 cubic feet of natural gas every day. This large quantity of rich fuel is used exclusively for melting and heating steel in the open-hearth furnaces and heaters, and comes directly from their gas wells in Pennsylvania and West Virginia through hundreds of miles of pipe, the main lines varying in diameter from 10 inches to 20 inches These lines are laid just below the frost line, and they follow the natural contour of the ground, over



GAS CYLINDERS OF RAND COMPRESSORS AT HUNDRED, WEST VIRGINIA.

mountains and under streams. The sections of pipe are joined by specially constructed couplings (not screwed) which allow for uneven alignment and the unavoidable expansion and contraction without any leakage.

The supply of natural gas, while still bountiful in certain localities, is gradually diminishing, in spite of the fact that prospect work on new wells is still under way. New fields command greater values today than ever before, and the wholesale waste following the earlier discoveries is by no means as common as it was.

The average depth of natural gas wells in this territory is about 2800 feet, though wells have been drilled to 3500 feet. One well drilled to this depth produced thirty million cubic feet per twenty-four hours; its rock pressure was 800 pounds per square inch, or an open flow pressure through a 6½-inch casing indicated 25 pounds per square inch. Some record wells have produced fifty million cubic feet per day, and rock pressure of 1100 to 1200 pounds are often encountered. The Carnegie Natural Gas Company now has several 1100-pound pressure wells shut in. The roar due to the flow of gas from a well before it is "shut in" can be heard for miles, and millions of cubic feet of gas escape to the atmosphere before it is possible to shut in a well of this kind, as this usually requires about twenty-four hours.

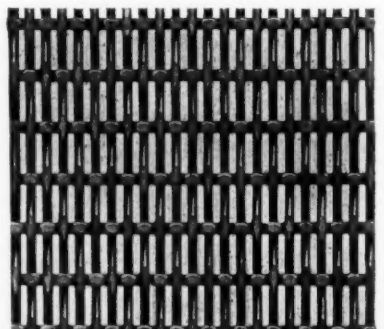
As the wells become exhausted, the natural pressures are lowered, and this means a diminished volume in the pipe lines and diminished returns on the investment. Additional or larger pipe lines would, of course, prolong the supply; but a much less expensive method for accomplishing this purpose is now resorted to, and that is to again raise the pressure by means of gas compressors.

The Carnegie Natural Gas Company, which is part of the United States Steel Corporation, has already installed compressor capacity which has an equivalent artificial yield of one hundred million cubic feet of natural gas per twenty-four hours. This capacity is represented by eight compressors located in three stations, each station being designed for reserve capacity over present requirements, so that all of the eight machines are not always in use.

The most recent and important of these plants, containing many new features and improvements, is located near Hundred, Wetzel County, West Va., a station on the Baltimore & Ohio Railroad. One view of the machinery is shown herewith, and owing to the novelty and importance of the work, The Rand Drill Co. have in preparation a technical description of the entire plant, clearly indicating the details and cost of plant, the method of drilling the wells and constructing the pipe lines, the dimensions and capacity of the gas producers, engines, boilers, the steam and gas piping under specified conditions, the condensing and feed-water equipment, together with indicator cards, and views of the buildings, etc. This detailed and valuable description The Rand Drill Co., 128 Broadway, New York, will be pleased to send free of charge to engineers and others who may be interested in similar plants in other natural gas regions.

Rolled Slot Screens.

A MARKED improvement on the screens hitherto in use for handling ore and similar materials is shown in the accompanying illustration, which represents



TYLER ROLLED-SLOT SCREEN.

the "rolled-slot screen," a new screen cloth especially adapted for stamp batteries, Huntington mills, and so on.

This wire screen has an oblong mesh and is rolled so as to present a smooth surface, in the latter respect being nearly similar to perforated metal. But the rolled-slot screen has a great advantage in its large amount of air space, which is double that in perforated metal. It has also decidedly more air space than the ordinary square-mesh wire cloth, and its construction is such that the particles of ore pass freely through it, without obstructing the apertures, as is sometimes the case with the old styles of screen.

Another point of superiority of the rolled-slot screen is that the crushed particles will pass through it as soon as they are reduced to the size of the aperture, whereas with the perforated screen the particles which are thrown against the blank spaces are returned to the crusher and so ground finer before they pass the screen, this having a tendency to slime the product.

Some interesting figures as to comparative results with different screens are supplied by the Mineral Point Mill, of the Homestake Mining Co., at Lead, South Dakota. In a hundred-stamp mill, running on a low grade of surface ore, in which one half of the batteries were equipped with No. 8 Russia-iron diagonal-slot screens, and the other half with rolled-slot screens of equivalent mesh, a twenty-day run showed an average daily tonnage of 4.57 tons per stamp with the diagonal-slot screen, and 5.64 tons per stamp with the rolled-slot screen, an increase of 24 per cent. with the latter. The nature of the ore in this particular case was favorable to easy crushing which acounts for the large absolute increase in tonnage, but in other experiments, where the tonnage was not as great as in this mill, there has also been a large relative increase by the use of the rolled-slot screen, and it may be said that on an average fifty stamps equipped wth rolled-slot screens will handle the same tonnage daily as sixty stamps with perforated diagonal-slot screens.

Further particulars regarding the rolled-slot screens will be furnished on request, by the manufacturers, The W. S. Tyler Company, of Cleveland, O.

Wood Rock Drills.

THE percussive rock drill has become an indispensable tool for mining, tunneling, quarrying and other kinds of rock excavation, and many of the great engineering works of recent years would not have been commercially practicable without it. When first invented it was, comparatively speaking, a heavy, clumsy and expensive mechanism, but even then it marked a great step in advance, and it has since been developed into the perfected machine of to-day, one of the finest examples of which, the Wood rock drill, is shown in the accompanying illustration.

WOOD ROCK DRILL.

The front head is made of malleable iron, held firmly by four bolts instead of only two, and the head is cored from the inside to receive two case-hardened bolts to hold the packing sleeve in place. This prevents the bolts from wearing the corners away, owing to the jarring of the drill, and falling out, as is the case where the slots are cored from the outside. The malleable iron washer, which fits into the sleeve in combination with the four grooves in the spring nuts, effectually prevents the nuts from unscrewing and falling off.

The packing sleeve is made of hard bronze and can be cheaply replaced when worn out, thus doing away with the expense of buying a new front head.

The air head is designed with a tapering recess for the three packing rings, which form the frustrum of a cone, and leakage is prevented until the packing is entirely worn out.

The rotating device is made of steel throughout; the spiral bar is made of one solid forging, and teeth are strong enough to resist the full power of the drill. The pawl holder is made of one solid forging, not a welded collar. The pawls are drop forged from tool steel. Four steel pins project from the pawl holder into the top head, which holds it firmly.

The valve is made of tool steel, moves automatically, and has no mechanical connection with the piston, to which it gives a variable stroke. As the end spools of the valve never cross a port, this type of valve never freezes when operated anywhere by compressed air. It is very light, does not wear fast, and never breaks. Only this one type of valve is used in the Wood drills, as it has proved to be the best kind for a rock drill.

The shell is of malleable iron, as are the caps, and has projecting lugs above its surface to prevent the caps from being forced back. It is bored at the back to receive solid forged steel standards, and a recess is cored to receive the nut on the end of the standards.

The coil springs, resting on the wrought-iron cross piece, receive the shock when the piston strikes the front head. These springs do not break, or wear out, and will retain their elasticity indefinitely.

The top head is made of malleable iron, and cored at the back to receive the steel feed nut. This is preferable to attaching the feed nut to the cylinder, for there is not power enough in the drill to break the malleable top head, while if held by the cylinder, which is cast-iron, it is more easily broken.

The piston is one solid forging, made of the very best piston steel. The piston bushing is made of steel and hardened on one side only. A slot is milled on the side where the chuck key fits. By using a cape chisel it can be sheared down the slot and easily forced out. The piston rings are made of steel forgings.

The cylinder is made of hard iron for long wear, and has an exhaust on either side. By changing the plug it can be made to exhaust right or left. Sometimes this is very desirable, especially in mines or deep cuts. The cylinder also has a bearing for the side rod to rest on, placed at the side of the cylinder under the exhaust pipe, which prevents the side rods from being bent if the drill is thrown down carelessly.

The tripod is made of steel and malleable iron. The legs are of extra heavy pipe, the top part of which is turned tapering and fits in a taper bearing. The lower portion of the bearing is slotted, and when the bolts are screwed up tight it holds the pipe firmly, and keeps them tight. It is made by templates or gauges, and one part is the exact duplicate of another. It is adjustable in all ways.

Many sizes of these machines, to be run with compressed air or steam, are manufactured by the Wood Drill Works, of Paterson, N. J., which make a specialty of rock drills and drill mountings, and devote all their energies to this end. They will be pleased to supply further information on request.

Almond Right-Angle Coupling.

IN the transmission of motion between lines of shafting at right angles to each other, by means of the usual devices, there is generally a lot of noise, a waste of lubricant and a great loss of energy. These losses and annoyances are eliminated by the use of the Almond patent coupling, which transmits power at right angles by a positive motion, which is noiseless in its action, consumes very little energy and is self-lubricating.

Its method of operation can be learned from the accompanying illustration, in which the crank arm F is connected with the slide A by the ball D and arm C, the opposite crank arm being connected with the slide A in a precisely similar manner. By revolving one of the crank arms, by means of the pulley K, or from the shafting direct, the slide A is carried up the post B and at the same time is given a rotary motion partly around the post; this motion is communicated to the opposite crank arm, and thence to the pulley and the shafting. Either crank arm can drive or be driven.

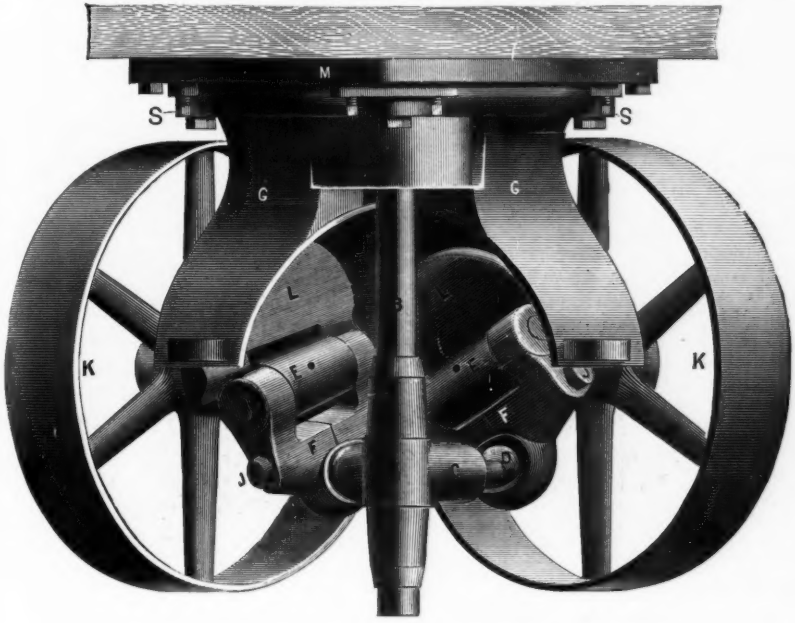
Perfect lubrication is effected by introducing oil into the lower half of the frame G (not shown in the illustration), which forms a closed receptacle, and when in motion the arms F, F, in connection with the slide A, will rapidly distribute the oil over the interior of the frame, by which means it reaches the parts to be oiled.

When it is intended to take motion from a central portion of the line shaft, the coupling is suspended from the ceiling at a suitable distance, and connection made with the main line by belt; the shaft to be driven may then be belted in the same way, or it may be connected direct by some suitable means. When pulleys are used, they are fitted to a bearing which is solid with the frame, so that no belt pressure or strain other than torsional may come upon the shaft A.

A template or suspension plate M is furnished with each coupling, for the purpose of easily locating its position. This plate has lines marked on it, and a center point at their intersection. These lines make the same angle with each other as the shafts to which the coupling is to be attached, and should, when the plate is in position on the ceiling, stand plumb with the centers of the driving and the driven shafts, the center point being as nearly as possible right over the point of intersection of the shaft axes. Bolts are provided with this plate for securing the frame G. The set screws S, S are for vertical adjustment, there being eight of them for that purpose.

The holes through which the bolts go for securing the frame to plate M are of a size large enough to allow a lateral movement of the frame to an amount of three-quarters of an inch in every direction. From this it will be seen that the adjustment is quickly accomplished, for if the frame G be loosely hung to the plate M at about the right height, and the connections made, it will settle itself to its position laterally, and may then be carefully adjusted vertically by the set screws and suspension bolts, and firmly secured in position.

The Almond coupling is manufactured of the best material and by the most modern



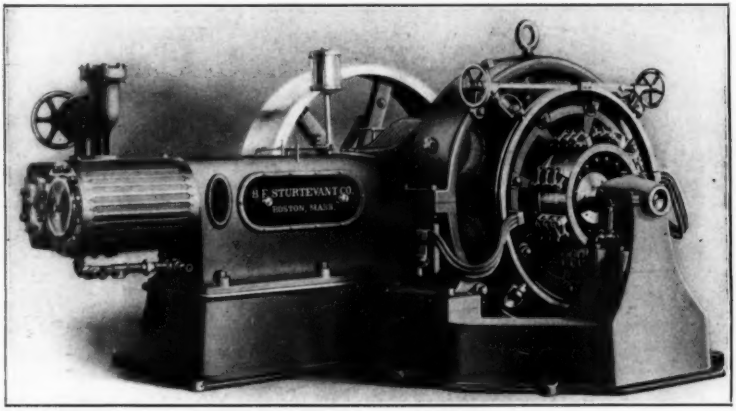
ALMOND COUPLING, SHOWING LOWER HALF OF FRAME REMOVED.

methods, the parts being worked to micrometer gauges. It has stood the test of time, and has given the greatest satisfaction in the prominent manufacturing establishments where it is in use, and has received the John Scott Medal on the recommendation of the Franklin Institute.

Further information concerning this coupling, as well as of their other specialties, may be obtained from the T. R. Almond Manufacturing Co., 83-85 Washington St., Brooklyn, N. Y.

A Sturtevant Generating Set.

IN response to the growing demand for a high-class generating set at a reasonable price, the B. F. Sturtevant Company are manufacturing a type, illustrated herewith, which supplies this want. Years of experience in the manufacture of both units have enabled them to perfect such a set.



STURTEVANT GENERATING SET.

The general design of the engine embodies all the latest improvements of the horizontal type. The reciprocating parts are substantially constructed and counterbalanced with lead load discs. A feature of construction is that of forging the crank-shaft solid in one piece and shrinking the discs onto it. A special arrangement of the Rites governor gives a regulation within 1 to 1½ per cent. from full load to no load, and by a modification of the Marshall valve gear an adjustment of the cut-off from zero to 70 per cent. is attained. The main bearings, crankpin, valve stem and slides of this engine are well babbitted with the Sturtevant white metal. A recent and important improvement is the watershed partition which prevents the water from the piston-rod stuffing box from reaching the interior of the engine frame, and the oil on the reciprocating parts from being thrown out into the engine room. The main body of the engine is enclosed on both sides by removable plates, as may be seen from the illustration, and the crank webs are enclosed by a cast-iron hood having two holes with removable covers, one for the purpose of cleaning the crankpin box while it is in motion and the other for removing the box without taking off the large hood. Between the watershed partition and the front end of the cylinder is a hand-hole for reaching the stuffing box bolts without communication to the oil spaces.

There are two oiling system for this type of engine, the gravity or tank system and that by forced pump lubrication. With the gravity or tank system, shown in the illustration, an oil tank supplies the pipes leading to the parts to be oiled. At each point where the oil is delivered is a little gauge glass and valve for regulating the flow at that point. A valve just below the tank regulates the entire oiling system.

The generator of this set is of the eight-pole type, and is capable of carrying momentary overloads of 50 per cent. without any shifting of brushes or flashing of the commutator, and an overload of 25 per cent.

for a period of two hours without undue heating. After a continuous run of ten hours at full load, the increase in temperature above that of the surrounding air never exceeds 40° C. upon the armature and field coils, and 45° C. upon the commutator.

The average temperature rise is about 33° to 35° C. Before being shipped, the generator is given a break-down test of 1,500 volts, alternating, for sixty seconds between the conductors and the frame of the machine to test the insulation. The magnet frame is of the best grade of cast iron, split horizontally. The pole pieces are of wrought iron with cast iron shoes or horns, and are secured to the magnet frame by through bolts. Any of the pole pieces may thus be removed to repair the field coils.

The armature is of the ironclad, form-wound, ventilated-drum type, having a core built up of charcoal iron plates, which plates after being thoroughly japanned are mounted upon a cast-iron spider and securely held in position by end flanges. No bolts pass through the armature laminations. The armature spider has an extension upon which is mounted the commutator, making the armature and commutator one unit. In the construction of the commutator, only drop-forge or drawn segments are used, these being secured in cast-iron shells of spider construction and clamped in place with a steel ring. Carbon brushes only are used, the commutator being so proportioned and the brushes of such size as to allow at least one square inch of brush area to every 30 amperes carried. These brushes are carried in holders of most approved construction, each mounted upon a self-contained brush rigging so arranged that the entire set of brushes may be rotated completely around the commutator.

Additional details concerning these generating sets will be supplied, on request, by the B. F. Sturtevant Co., of Boston.

Ashton Inspectors' Testing Outfit.

IN inspecting and testing work it seldom happens that all the necessary instruments are available at the plant, and even if they are there, it is better for the inspector to have his own, which he knows to be absolutely reliable.

For these reasons the outfit which is herewith illustrated will be found very convenient. It is particularly designed to meet the requirements of boiler and power plant inspectors, mechanical engineers and chief engineers, as it is accurate, durable, of light weight and easily portable. The outfit consists of the following nickel-plated instruments: Three-inch standard test gauge, screw test pump, gauge hand puller, hand set, lever handle, union gauge cock and screw driver, all neatly and compactly contained in a velvet-lined leather case, fitted with lock and handle.

ASHTON INSPECTORS' TESTING AND PROVING OUTFIT.

The approximate weight of this outfit is eight pounds, and further information concerning it, as well as of their other products, will be furnished, on request, by the

makers, The Ashton Valve Company, of 273 Franklin St., Boston, Mass.

Otis Feed-Water Heater, Oil Separator and Filter Combined.

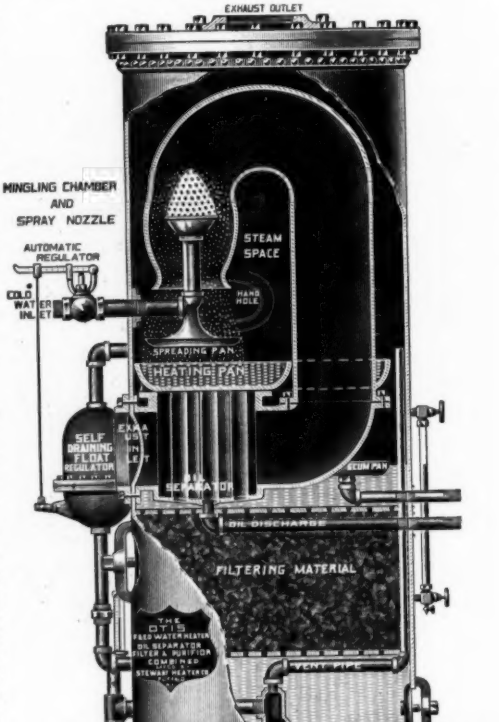
UPON the proper utilization of the exhaust steam and the purification of the feed water depend, in a large measure, the efficiency and proper operation of a steam generating plant, and so an apparatus which unites these functions is of especial interest.

Such an apparatus is shown in the accompanying illustration of the Otis feed-water heater, oil separator and filter combined. This heater consists of a steel shell with cast-iron heads, sustained by four cast-iron legs bolted to the conical bottom, thus making a substantial base for the heater.

The exhaust steam enters the heater at the side and passes directly into and through the oil separator, where the oil that is carried over with the exhaust steam from the engine cylinder is separated and passes out at the bottom of the oil separator through the oil discharge pipe. The exhaust steam then passes on into the mingling chamber or spray condenser, where it is brought into direct contact with the spray of cold water, and as the spray of cold water and exhaust steam cannot separate until they both pass out at the bottom of the mingling chamber together, the water is heated as hot as the exhaust steam. The exhaust steam then circulates freely through the steam space and passes out at the opening on top. This steam can be used for other heating purposes, if required, as all the water of condensation is deposited in the heater, and this exhaust steam will carry no water out with it. Therefore, no exhaust head will be required where this heater, oil separator and filter is used.

The feed-water pipe enters the side of shell, turns upward and projects into the mingling chamber, where it terminates in a conical spray nozzle.

The spray of water is thus brought into direct contact with the exhaust steam as it enters the heater, and becomes instantly heated; the heated water then falls upon the spreading cone, where it is again sprayed or spread into the heating pan and flows over its edges before it can mingle with the water in the heater.



OTIS FEED-WATER HEATER.

The heated water is then in the proper condition to deposit the impurities, and as it passes down through the filter or filtering chamber, the clay, sand and other matter in suspension, the carbonate of lime and magnesia in solution are separated, and the pure water enters the pure-water chamber,

which is of large capacity, to allow any particles of sediment that should be in the water to settle in the bottom, and it can be blown out at any time by opening the blow-off valve.

The supply of water to the heater is automatically controlled by the float and regulating valve, which keep the water at the proper level in the heater at all times.

The float is self-draining or unsinkable, the stem being a brass tube, so should there be any leak, the water could pass off through the stem and the float retain its buoyancy. These floats are made of copper and are tested to 200 pounds.

The float is placed in a separate chamber, attached to the heater shell at the top and bottom, so that any variation in the water level in the heater will cause the float to rise or fall, thus opening or closing the regulating valve, and keeping just the proper amount of water in the heater. The automatic regulating valve is a balanced valve, very positive in its action, and is operated with a very slight movement of the float.

The filtering chamber is very easy of access, and the filtering material can be removed when necessary and the chamber refilled in a few minutes. None of the scum or oil can get into the boilers, as the pure water is taken from the center of the water chamber, and the hot water or suction pipe to the pump is furnished with a vent pipe, so that should the supply of water be shut off and lower the water in the heater, the pump would stop pumping and prevent any of the scum getting into the boilers.

These heaters act well as an expansion tank to overcome the pulsation; and also as a receiving or condensation tank, for the water of condensation from the heating system in the building can be returned through them and again pumped to the boiler as pure water.

All of the exhaust steam should be passed through the heater, to extract the oil that is carried over from the engine cylinder before being used for other heating purposes.

The exhaust steam can then be used to good advantage in the heating coils, without filling them with oil and grease.

Thus these heaters not only heat the water to the boiling point, 212° F., but will automatically control the water supply, take all the sediment out of the feed water that can be taken out with the exhaust steam, and extract the oil from the exhaust, without the extra expense of an eliminator.

Further particulars regarding this apparatus may be obtained from the manufacturers, the Stewart Heater Co., of Buffalo, N. Y.

Weber Steel-Concrete Chimneys.

REINFORCED concrete, or concrete steel, as it is often called, has been making great progress as a structural material of late years, and from its early use in bridges it has been developed so that it is now employed for beams, columns, pipes, walls and buildings and structures of all kinds.

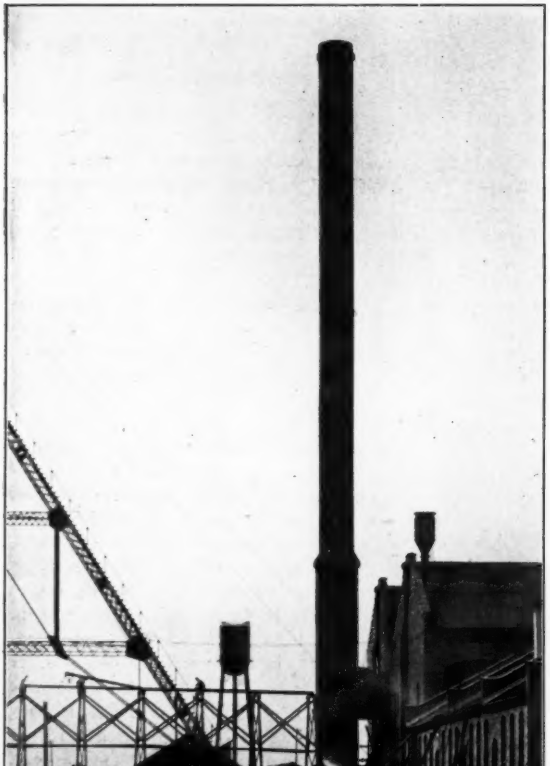
One of its more recent applications has been in the construction of chimneys, which has been carried to a high point of excellence by the Weber Steel-Concrete Chimney Company, of Chicago.

This company makes a specialty of building reinforced-concrete chimneys, among the advantages of which are the following:

They are monolithic, the whole chimney, from base of foundation to top, being one solid piece of concrete, reinforced by steel, and therefore almost indestructible. These chimneys are of the highest working capacity, because they are absolutely air tight, and the flue is almost perfectly smooth inside and has a uniform inside diameter. A Weber chimney can be erected in a shorter time than a brick or steel stack, and they take up much less room than a brick or self-supporting steel stack, which is a point of the utmost importance in a modern steam plant. A chimney of this kind is very light, even lighter than a self-supporting steel chimney, including lining and foundation, and the pressure on the ground is about one-fifth as much as in a brick chimney, so making possible the saving of a great deal of money otherwise spent for pile driving and other foundation work. A Weber chimney will resist the influence of the chimney gases and heat better than any other, and is capable of resisting a continuous heat up to 1,500 degrees F. without injury. Then these chimneys have a very handsome appearance, the light gray color of the chimney, in connection with the ele-

gant and graceful outlines, giving an artistic effect that cannot be produced in a brick or steel chimney.

A Weber steel-concrete chimney which has been built for the Ziegler Coal Co., at Ziegler, Illinois, is shown in the accompanying illustration. This chimney is 154 feet high and has an inside diameter of 6 feet. The total weight of this chimney, including foundation, is 556,090 pounds, and the base of foundation is 6 feet 6 inches below ground. The chimney consists of two distinct parts, the lower part having a double shell, while the part above the offset is single. The outer shell of the double part is 6 inches thick and the inner shell, which acts as a lining, has a thickness of 4 inches, the shells being divided by a circular air space of 4 inches. The single shell above the offset is 5 inches thick, tapering to 4 inches. The work for this chimney was commenced March 5th, 1904, and was finished and the chimney ready for use on May 1st. The chimney is built to withstand a wind pressure of 50 pounds per square foot, projected area, corresponding to a wind velocity of 100 miles per hour, which is much more than brick or steel chimneys are usually calculated to resist. All the work was done from an inside scaffolding and ladder, and no outside scaffolding was used for the construction of the chimney. A large number of these chimneys have been built by the Weber Company, who now have under construction a chimney 300 feet high and of 18 feet inside diameter for a large smelting plant in the West. After completion, this chimney will not only be the largest concrete chimney ever erected, but will also be one of the largest chimneys in the country, only a very few exceeding it in diameter or height. A Weber chimney already built for the Burt Portland Cement Co., at Bellevue, Mich., is 182 feet high and 8 feet in diameter.



WEBER STEEL-CONCRETE CHIMNEY AT ZIEGLER, ILL.

The Weber Steel Concrete Chimney Co., of Chicago, will be pleased to supply further information concerning these fine structures.

Howard Watchman's Clock.

NO matter how faithful a watchman may be, it adds to his efficiency and to the feeling of security enjoyed by his employer if a definite record can be made which will show without question that he has performed his duty properly.

Such a record may be obtained by the use of the Howard electric watchman's clock, which has fully demonstrated its value by a long term of successful service, improvements having been added from time to time to keep it entirely up to date.

In the Howard system the record is made on a circular sheet of paper in the clock by means of needles actuated by electromagnets. The current is furnished by a primary battery, and is led through a two-wire circuit, which includes the clock and all the stations that the watchman is to visit, the stations being connected in parallel. Each station makes its distinctive record, which cannot be mistaken for any other.

It is not necessary that the boxes or stations be visited in any particular order or an equal number of times, for the record of each box is given independently of any other, and the route of the workman may be changed, the record showing just what course he has taken. When a watchman reaches a station he inserts his key, which fits all stations alike, and gives one full turn, after which the station automatically makes the record by allowing the electric current to pass through contact pieces which are different for every station, and so making a distinctive record at the clock where the time of the record is also shown on the paper dial. This system does not require that the watchman should be at a given point at a stated time, as each station may be recorded at any time.

A new needle has recently been designed for the Howard clock, for perforating the paper dial when the watchman registers. In some large buildings the watchman must make a hurried round, a practice which the Howard Company discourage when possible, because the greatest efficiency on the part of the watchman cannot be obtained when he goes too rapidly from one station to another. But as such instances do occur, the company have made a change in the registering device of their clocks. The blunt point ordinarily used with their apparatus does not penetrate the paper, but indents it, spreading the texture, so that when stations are rung in rapid succession the indentures run one into the other, making it difficult to read them. The Howard system enumerates the stations by punctures:—that is, No. 1 station registers one puncture; No. 5, five

HOWARD CLOCK FOR TWELVE WATCHMEN.

punctures; No. 14, a puncture, a wide space, and then four punctures close together—a great advantage of this being that no watchman could accomplish the registration of a box, otherwise than from its station, by getting track of the wires and causing a contact. He could register, but he could not space as the mechanism spaces, and any

such attempt would be easily detected. But with a blunt point when two stations are registered in rapid succession the two merge on the dial. The substitution of a sharp needle, which perforates the paper instead of indenting it, obviates this difficulty, because it is easy to read the registration of the dial even when the stations are rung within a minute of one another, or even less.

The clock has so little to do in fixing the time of the records that its timekeeping qualities are in no way impaired, and it can be relied upon to maintain standard time. A clock can be fitted to accommodate any number of watchmen, the one shown in the illustration being arranged for twelve, its capacity being only limited by the space reserved for it. Any number of stations can be added to or removed from the system without interfering with those remaining. Any one may have free access to the clock, and still a record made in any other way than that intended will surely be detected. The cases are made in the most thorough manner, the doors setting in a rabbet and being provided with a Yale lock. When desired, a recorder is attached which prevents the door from being opened without making a record on the dial.

The record of the watchman's rounds is a permanent one and cannot be erased, as it is made by punctures through the recording dial, which can be filed for future reference. This is of decided importance when a reduction in rates of fire insurance is under consideration.

The clock may be placed in the office or in any building near to or remote from the watchman's territory, two wires, only, running from the clock through the building, being necessary for any number of points which the watchman is required to visit on his rounds. This makes the wiring very simple, and facilitates the placing of additional stations, as may be desired.

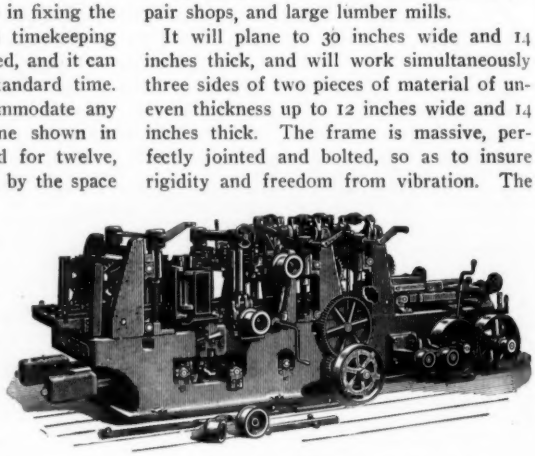
The E. Howard Clock Company, of 401 Washington St., Boston, Mass., will be pleased to furnish further information concerning this system.

Double Cylinder Planer, Matcher and Jointer.

A NEW heavy six-roll, double-cylinder planer, matcher and jointer, which has lately been brought out by a large manufacturer of wood-working machinery, is shown in the accompanying illustration.

This is one of the largest and heaviest combined planers and matchers built, and is especially useful for car building and repair shops, and large lumber mills.

It will plane to 30 inches wide and 14 inches thick, and will work simultaneously three sides of two pieces of material of uneven thickness up to 12 inches wide and 14 inches thick. The frame is massive, perfectly jointed and bolted, so as to insure rigidity and freedom from vibration. The



J. A. FAY & EGAN PLANER, MATCHER AND JOINTER.

steel cylinders are slotted on all their faces, and have chip breakers for working cross-grained or knotty lumber. The matching works are very substantial and of improved construction, and are fitted with a patent weighted matcher clip for producing an even pressure on the material.

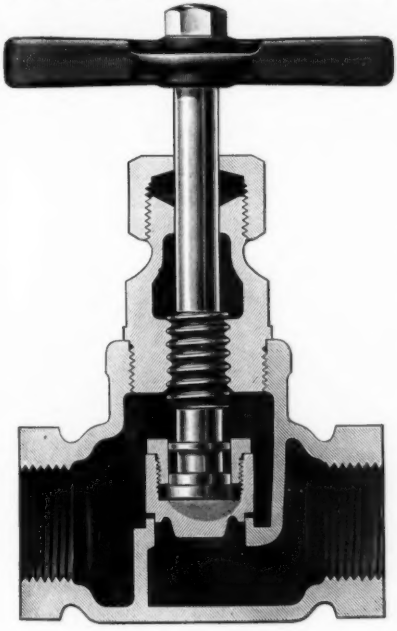
The feed works are very powerful, consisting of six driven rolls, which are easily raised and lowered, and are heavily weighted. The rolls are divided, have accurate adjustments and are always kept in true alignment. The feed is powerful, steady and uniform, and its rate can be furnished as desired.

This machine will be found to possess many other devices for facilitating the work and making the several adjustments, and further particulars can be obtained from the makers, J. A. Fay & Egan Co., of No. 212 to No. 232 W. Front Street, Cincinnati, Ohio, who will also send free to those interested their new illustrated catalogue of wood-working machinery.

The Hancock Valves.

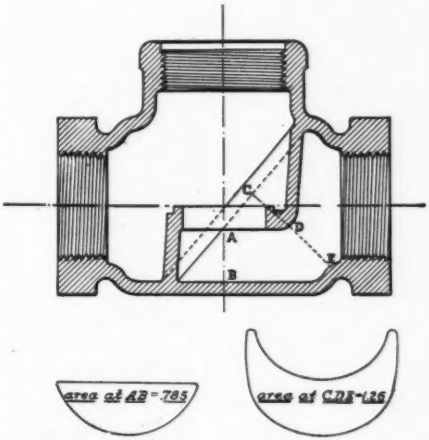
THE Hancock globe, angle, 60° and cross valves are made after the same general design as the Hancock main steam valves, used on locomotives for a number of years and found to give perfect satisfaction with the high steam pressures carried. These valves have been designed so that the metal is distributed to give uniform strength throughout and the areas have not been reduced or contracted for the purpose of reducing the weight, and from the illustrations of a globe valve shown herewith it will be seen that the area of the most contracted part of the valve is ample and of full size.

Attention is called to the way the valve is guided on the stem. An inspection of the section of this valve will show two collars or guides upon the stem which guide the disc nut, thereby compelling the disc to always seat squarely and absolutely



HANCOCK GLOBE VALVE.

preventing it from cocking. The valve seat is flat, which form has many advantages over any other used in valves of this character. The valve disc has a projection on it which serves two purposes. In the first place it acts as a guide when the seat is ground, and in the second place, this lip or projection on the disc prevents the cutting



SECTION OF HANCOCK GLOBE VALVE, SHOWING AMPLE AREA.

of the seat by the wire drawing of the steam when the valve is cracked or slightly open.

Again, when the valve is slightly raised from its seat, with the lip entering slightly, it allows the escaping steam to clean the seat, so that when the valve is seated again all dirt and foreign matter has been washed or blown completely off the seat. This is a most important feature, as experience has fully demonstrated that when the Hancock valve begins to leak it requires a very little regrinding to make it tight. This is accomplished so easily that a tight valve can be maintained for a long time with extremely little labor and expense.

The bonnets of these valves are made with a long thread engaging the body of the valve, and the shoulder on the bonnet is made narrow. By means of this narrow seat on the shoulder, it is possible to keep the bonnet tight, and when it is desired to unscrew the bonnet, it can be easily done. This is a decided improvement over the form of bonnets having a wide shoulder bearing upon a wide surface on the top of the body of the valve.

When it is necessary to regrind the valve to its seat, the bonnet is removed and the

disc nut unscrewed from the disc, and a piece of wood can be inserted in the disc, enabling it to be ground perfectly as the projection on the disc guides it, it not being necessary to have any special regrinding tools for this purpose.

TEE HANDLE OF HANCOCK VALVE.

The tee handle on the Hancock valve has proved to be so much more efficient in opening and closing that it has become popular among the users of these valves, and the demand is so universal that all valves sent out are equipped with the tee handle. Its advantages are especially apparent on steamships, where there are a multiplicity of valves and economy of space is necessary.

The illustration shows the peculiar method of attaching the tee handle. The hole in the handle is made tapering with one side flat, and the spindle of the valve is also made tapering with one side flattened to receive the handle, the tee handle being held on the spindle by means of a nut. The flattened side holds the handle rigidly in its place, and the taper enables the handle to be drawn tightly to the spindle, so entirely avoiding the great annoyance of the handles or wheels working loose, which happens when they are attached by the old means of a square only.

In order that the valve seat may be hard and durable, the body is made of a specially hard and tough mixture. The discs are made of a special mixture which does not contain any zinc. The spindles are all made of Tobin bronze, experience having demonstrated that a Tobin bronze spindle working in a special composition bonnet will not cut under the highest steam pressures.

The Hancock globe, angle, 60° and cross valves are made screwed and flanged in sizes up to 3 inches, and are of one standard only, for all pressures. Under actual test, the bodies of these valves will stand a pressure of 4,000 pounds per square inch without breaking, and it is guaranteed that each and every one of them has been tested with 1,000 pounds water pressure and found tight before leaving the manufacturer's works, and that they will stand 500 pounds steam pressure.

These valves are made by the Hancock Inspirator Co., whose general office and salesroom is at 85-87-89 Liberty Street, New York, and who will be pleased to supply further information on request.

Jeffrey Hammer Pulverizer.

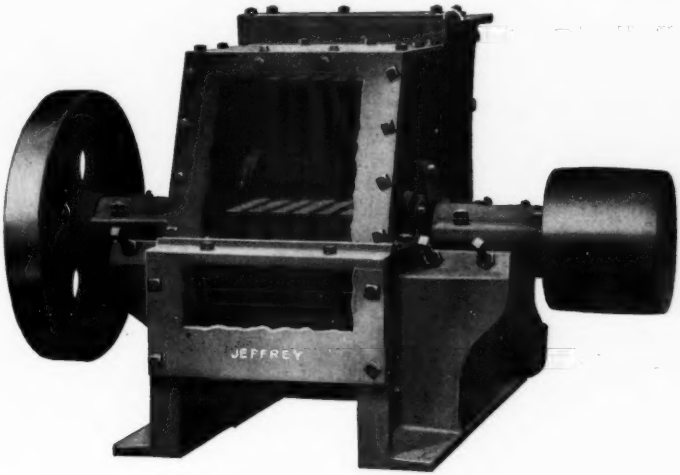
THE manufacture of the hammer type of pulverizer has recently been taken up by the Jeffrey Manufacturing Company under the Schoellhorn-Allbrecht patents. One of the accompanying illustrations shows the pulverizer with its interior or crushing parts; the other shows the sectional screen frame, which is one of the special features in this machine.

This pulverizer is designed for crushing and pulverizing substances such as coal, clay, shale, rock, and many other materials, and it is claimed to be the simplest machine of its kind made. Among its strong features are its simple beater hammer, its "V" shape bar screening surface, its simple adjustment of the beater arms to accommodate wear, its substantial dust-proof pillow blocks, and its top-feed hopper, which insures large capacity and permits material to be partly crushed while in suspension.

The accessibility of its inner parts is also one of its strong points. The taking off of the rear plate and the hand-hole plates on

the side of the machine make it possible to change the beater arms as well as the screen-

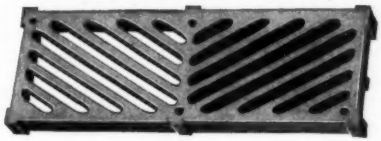
ject can be had by addressing the Jeffrey Manufacturing Co., Columbus, O.



JEFFREY HAMMER PULVERIZER.

ing when necessary. The screening surface is made up in sections, so that it is the work of but a few moments to take out or change from one size mesh to another.

Many of these machines are in use, so there is no experimental period to be gone through with. This pulverizer is made in many sizes to suit the various requirements; for instance, in coal the capacity varies any-



SECTIONAL SCREEN FRAME OF JEFFREY HAMMER PULVERIZER.

where from fifty to one hundred tons of coal per hour, depending entirely upon the degree of fineness. In pulverizing material such as rock its capacity is anywhere from ten to twenty-five tons per hour.

The Jeffrey Company make free crushing tests for interested parties, thus demonstrating, before sale, what the machine is capable of doing. Complete catalogue on this sub-

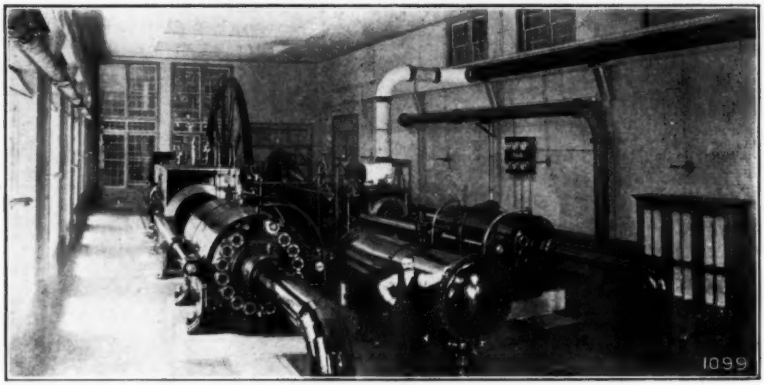
The Air Compressor Plant of the Homestake Mining Company.

COMPRESSED air has long been recognized as a powerful factor in economical mine operation, and in the Homestake Mine, at Lead, South Dakota, its possibilities have been developed to the utmost. As is eminently fitting, this mine, which is said to be the greatest gold producer in the world, has in its power plant the largest air compressor in the world, and this giant must receive the first mention in the list of machines on the Homestake lode. It is located at the Ellison shaft and is a cross-compound condensing two-stage Corliss machine, built by the Ingersoll-Sergeant Drill Company. The high- and low-pressure steam cylinders have a diameter of 32 and 60 inches, respectively, the air cylinders are 52¼ and 32¼ inches in diameter, and the stroke is 72 inches. At rated speed of 50 revolutions per minute, the free-air capacity is 9,000 cubic feet per minute, this volume being sufficient, under average conditions of mine work, to operate 125 rock drills. The steam pressure is about 130 pounds. The exhaust steam is received by a Wheeler surface condenser, in connection with a cooling tower. The well-known Ingersoll-Sergeant piston inlet valve

is used on both high- and low-pressure air cylinders, between which a horizontal intercooler is placed in the air circuit. The total weight of this huge compressor with its accessories is about 300 tons. It is placed beside the great Ellison hoist, the mountain being blasted out to make space for the engine room.

The output of this great machine is used exclusively for operating machine drills in the underground workings, and it is assisted by two smaller machines, built by the same maker and both of Corliss type, with piston inlet valve. One of these machines, located at what is known as the Old Abe shaft, is a duplex machine, with steam cylinders 24 inches in diameter. air cylinders 26¼ inches and a stroke of 60 inches. Its capacity in free air is about 4,400 cubic feet per minute. The other compressor is at the Highland shaft, and is of the same type as that just described. Its stroke is 42 inches, the air cylinders are 22¼ inches and steam cylinders 20 inches in diameter. At rated speed its free air capacity is about 2,600 cubic feet per minute. These two compressors, together with the giant at the Ellison shaft, are operating over two hundred Ingersoll-Sergeant rock drills in the mine workings.

In the hoist room at the Ellison shaft, not far from the largest compressor, is installed a small Ingersoll-Sergeant Class "GC" compressor, with duplex steam cylinders and two-stage air end. This is one of the smallest machines equipped with the piston inlet valve, and the contrast between it and the large machine adjacent is striking. The smaller machine has a stroke of 12 inches, its steam cylinders are 10 inches in diameter, high-pressure air cylinder 10¼ inches in diameter, low-pressure 16¼ inches. At rated speed of 160 revolutions per minute the piston displacement is 444 cubic feet of free air per minute. The air from this compressor is used in the cylinders controlling the starting, stopping, reversing and braking of the Ellison hoist. In this engine room is located a straight-line high-pressure compressor of the same make furnishing air at 900 pounds pressure to charge the storage tanks of a locomotive used in hauling ore cars between shafts and mills in the surface workings.



INGERSOLL-SERGEANT AIR COMPRESSOR AT HOMESTAKE MINE.

For various purposes in the mills and surface workings two other air compressors of Ingersoll-Sergeant make are installed. These are both of Corliss type, with piston inlet valves. The sizes of these machines are 12 and 16¼ inches, with 36-inch stroke, duplex type, and 12 and 18¼ inches by 36 inches, half duplex. Their combined capacity in free air is about 2,100 cubic feet per minute.

Further particulars regarding this interesting plant may be obtained from the Ingersoll-Sergeant Drill Co., of 26 Cortlandt Street, New York.

IMPROVED MACHINERY

New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Jessop's High-Speed Steel.

THE ever-present problem of increasing manufacturing capacity and efficiency has brought about a widespread interest in high-speed steel. Although a comparatively new development in tool steel making, this product is now far past the experimental stage, and must be reckoned with by every manufacturer who aims to keep abreast of the marvelous progress that has been made in the manufacture of machine tools during the past decade.

But in adopting a brand of high-speed steel for his particular purpose, the manufacturer must use as great care as in selecting carbon steel—since the composition and working properties of each brand differ, and give very different results.

In every quality necessary to the production of high-speed tools, Jessop's "Ark" high-speed steel has fairly won a preeminent rank. This celebrated firm (established in 1774) claim to have improved upon all existing methods of producing this grade of steel, and now offer an article that gives truly astonishing results—because the tools can be operated at three to five times regular speed. In fact, there are few lathes that can be worked fast enough to do full justice to this steel.

The tools "stand up," and no matter how hot they may become, they will go right on cutting without danger of injury to the steel.

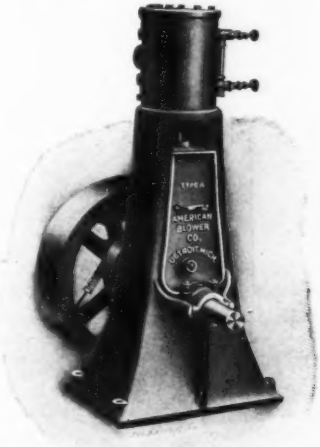
Jessop's "Ark" high-speed steel is guaranteed to be of uniform quality—it never varies. Results obtained to-day can be obtained to-morrow or next week. It is equally good for light or heavy work—from the largest milling cutters to small tools in holders.

The firm invites inquiries regarding the working properties of steel for any given purpose; and they carry a full stock of this steel at the main warehouse in the United States. Address Wm. Jessop & Sons, Ltd., 91 John Street, New York.

"A B C" Vertical Engine with Automatic Lubrication.

THE illustrations presented herewith show a new vertical steam engine which possesses unique features of merit. It is fully enclosed, thus preventing foreign matter from getting into the working parts, yet the latter are easily accessible upon the removal of the enclosing plates, by simply turning a milled hand nut and lifting out.

The most remarkable feature of the engine is its oiling system. Automatic lubrication of engines has been one of the details very slow in development. Up to the present time it has been confined almost



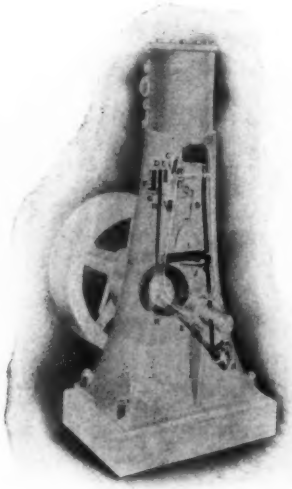
"A B C" VERTICAL ENGINE.

entirely to the splash system, which is seldom thoroughly effective, and for vertical double reciprocating engines is often unreliable.

Such attention as this detail has received has been applied to large horizontal engines, which are less likely to prove annoying through defective lubrication than are the small high-speed, vertical engines.

In this engine frictional surface runs in oil, there being no positive contact between metals.

The oiling is done by the engine itself, and instead of a drop or two a minute each



PHANTOM VIEW "A B C" ENGINE.

bearing has a stream of oil. By referring to the "phantom" illustration the operation can be easily traced. An eccentric K on the shaft actuates the plunger L of the oil pump A, forcing the oil up through the tube B into the small strainer C. From C it drops into an oil box through the bottom of which four tubes project. In one side of each of these tubes there is a slot, so that when the oil box contains only a small amount of oil, each tube can take its proper proportion. If the box is full all the tubes get more oil in proportion to the increased height.

Two of these tubes, F and one on the opposite side, not lettered, apply oil to the crosshead guides, the oil dropping into a small oil trough G, from which it runs into the bearing through a small oil hole. The crosshead pin is supplied by the tube marked E; the oil drops into the cup H and fills the cavity between the bolt and inside of crosshead pin and the oil grooves. The oil dripping from the crosshead is caught in two pans attached to the inside of the covers. From these oil pans it runs down the inside of the cover, dropping into a cup in the top of the main bearing cap. Instead of oil grooves at the top and bottom of the main bearing, as ordinarily made, in this system the bearing is cut away at the joint. When the train from the connecting rod is up, the oil is carried to the bottom of the bearing; but when the load is reversed, there are no oil grooves to carry away this oil. The crank pin is oiled through the tube marked D. This tube discharges into a crank oil ring inside the eccentric K which in turn discharges into the crank-pin oil tube, and flows across the crank-pin bearing. The crank-pin oil ring in addition to its independent supply catches the drip from one end of the main bearing. The eccentric is oiled by the drip which it catches from the other end. Not the least difficulty has been experienced in catching the oil thrown off the eccentric strap and the splash from the crosshead has been equally easy to take care of, the outside of the engine being absolutely free from oil. A portion of the oil as it drips back into the bottom of the frame falls upon an oil filter where it is thoroughly cleaned and purified. The large base gives the oil an excellent opportunity to cool and settle.

In their own shops the manufacturers have been experimenting with this engine for some two years past, and in connection with their experiments relate a novel experience. An engine was adjusted and filled with oil; after four months no readjustments of any character had been made, and no oil added except to fill the sight feed cylinder lubricator. The engine has been operating from fourteen to sixteen hours per day driving a blower, and after the lapse of over four months needed no readjustment or fresh lubricant, and was running almost as noiselessly as at the first.

It will, therefore, readily be seen that this engine is particularly valuable for use where continuous operation is required or peculiarly heavy duty is imposed upon the engine, as in driving blowers, dynamos, pumps, and similar apparatus.

Further information can be obtained from the designers and builders, the American Blower Company, of Detroit.

The "Little Gaint" in Coal Mining.

IN rock work encountered in sinking shafts and driving drifts and slopes in American coal mines, the "Little Giant" rock drill is capable of doing the greatest amount of work with the greatest economy of maintenance. The construction of this drill fits it particularly for drilling in all kinds of rock throughout the coal fields as well as in mines producing metal ores. To meet the exact requirements of coal miners, the Rand Drill Company of New York have so modified their standard rock drill that they are now offering, in the "Little Giant," a drill which is specially adapted to coal mining; and its effectiveness in this work is securing its rapid introduction in every principal coal-mining region in the country.

We present an illustration of the "Little Giant" at work in a mine in the West; and the chief points which distinguish the machine from all others employed for like purposes, are as follows: It muds well, i. e., the drill throws the mud out of the hole at each stroke, enabling the drill to cut fresh ground; the positive valve movement insures certain operation when steam or air is admitted, without dependence upon close fits or clean parts; it allows of a variation in design between the up and down stroke, thus economizing steam and increasing the working capacity of the machine; the clean and sharp cut-off is the principal cause of its steam or air economy; the whole mechanism is so simple and direct that there is never any difficulty in running

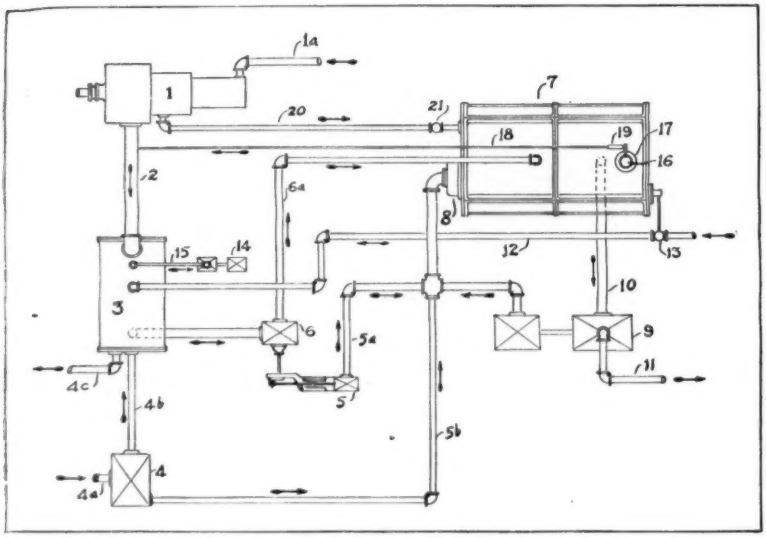
A LITTLE GIANT DRILL AT WORK IN A MINE NEAR BUTTE, MONTANA.

at any desired speed; and there is no waste of power (due to leakage) after long and constant use.

The Rand Drill Company, 128 Broadway, New York City, will be pleased to supply descriptive matter, illustrations, and detailed information as to the profitable use of this drill in coal mining particularly, as well as its past performances in other drilling work.

New Feed-Water Heater.

AMONG the new problems and opportunities presented by the recent commercial development of the steam turbine is the application of the auxiliary equipment in plants operated by turbines. The Harrison Safety Boiler Works of Philadelphia have paid special attention to the adaptation of the Cochrane heaters to such plants, and they have developed some features in these installations which should prove of considerable interest to engineers. The accompanying illustration shows an approved method, designed by them and covered by letters patent, for heating and regulating the boiler feed water, and is particularly adapted to plants where the steam turbines are operated in connection with surface condensers, although this method is also applicable to plants where surface condensers are used in connection with reciprocating engines.



NEW HARRISON FEED-WATER HEATER.

1 is the main steam turbine taking steam through the pipe 1a from the boiler; 2 is the exhaust pipe from the turbine to condenser; 3 is the surface condenser receiving the exhaust from 2; 4 is a pump taking cold water through suction pipe 4a and forcing it through pipe 4b into the condenser to condense the exhaust steam therein, 4c is the discharge for the circulating water from the condenser; 5 is an auxiliary engine driving a pump, 6, for drawing the condensation of the steam from the condenser and delivering it to the open heater through the pipe 6a; 5a is the exhaust pipe from this auxiliary engine joining the exhaust 5b from 4; 7 is a Cochrane feed-water heater receiving the exhaust from the auxiliaries through the oil separator 8; 9 is a pump taking the feed water from the heater through the pipe 10 and discharging it to the boilers through the pipe 11. The exhaust from this pump,

joining the other auxiliary exhaust, enters the separator 8; 12 is the supplementary cold water feed supply emptying into the condenser, 3, to make up any difference between the quantity of the condensation of the steam and the amount of water required by the boilers. The supplementary water is controlled by the valve, 13, according to the level of the water in the heater, 7 (this valve is automatically closed or opened by the float and connecting mechanism); 14 is an air pump exhausting air from the condenser 3 through the pipe, 15 (in cases where this pump is steam driven the exhaust also enters the separator, 8); 16 is the exhaust from the heater to the atmosphere and is provided with a back pressure valve 17; 18 is an air pipe leading into the condenser and provided with the air valve, 19, for passing to the condenser the air which is liberated from the water by heating it in the heater. By this means the air in the heater is disposed of without permitting the escape of steam.

Should there be more exhaust from the auxiliaries than can be condensed in the heater, the pressure increases until it is high enough to open the back-pressure valve, 17, and allows the surplus to escape to the atmosphere. It often occurs, however, that the steam from the auxiliaries is insufficient to heat the feed water to the temperature of the steam itself. In order to cover such cases the pipe 20 is carried to the heater from such a point of expansion in the turbine as will insure the least loss of effectiveness with the greatest potentiality for the purpose of making up any possible deficiency in the auxiliary exhaust. In the pipe 20 is placed an automatic throttling valve, 21, so adjusted that the pressure of the steam when it enters the heater shall be below the pressure at which the back-pressure valve 17 is set. Thus the supply of supplemental steam from the turbine depends upon the pressure in the heater, and is regulated by the needs of the heater itself.

The operation of this novel arrangement has important advantages. In addition to all of the condensation of the main exhaust being utilized in the heater, the supplementary cold water is automatically regulated and supplied, and is partially heated in the condenser by the utilization of the latent heat in the main exhaust. All of the exhaust from the auxiliaries is utilized up to the point where they provide more exhaust than is required in the heater, and should the supply fall below the maximum quantity required it is automatically supplemented by steam in the manner already described. The boilers are furnished with water at a uniformly high temperature, there being no sudden fall in the temperature due to variations in the quantity of steam available for heating the water or in the quantity of the supplemental cold water required. The methods by which these desirable results are obtained are single, positive and entirely automatic.

It will be seen that in a plant in which this method of heating and regulating the boiler feed supply is used the auxiliaries are of the independent, steam-driven, non-condensing type. The manner in which the exhaust from these auxiliaries is utilized, however, makes them far more economical than the turbine or main engine run condensing, even though the latter may show an efficiency of 15 per cent. or better. If the auxiliaries were run condensing they could not exceed and probably would not equal this efficiency of 15 per cent., but when operated in the manner described above, their efficiency is practically 100 per cent. for all of the heat in the steam which is not converted into work or accounted for by losses from radiation, etc. (and these quantities would be identical whether the auxiliaries were run condensing or non-condensing) is utilized in heating the feed water and turned back into the boilers. This efficiency of 100 per cent. compares with the absolute loss of 85 per cent. which must occur if the auxiliaries are run condensing and the heat in the exhaust dissipated and wasted in the condensing water.

The Johnson Patent Arch Plate.

THE Johnson patent arch plate for facilitating the work of repairing and rebuilding furnace door arches, is shown in the accompanying illustration. The arch plate when in use is attached to the ram of the charging machine. The furnace door is raised out of the way and the charging machine inserts the plate in the charging opening of the furnace, holding it there in proper position until the repairs

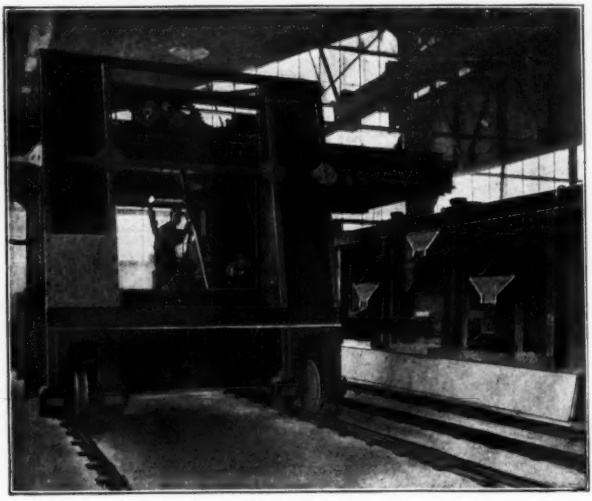
are completed, when it is withdrawn and detached from the ram of the charging machine.

The arch plate serves, first, as a shield against the heat from the interior of the furnace, thus enabling the work of repairing the arch to be carried on without shutting down the furnace. In repairing arches without this device, it is necessary to build up a temporary protecting wall or bulkhead of brick; and on account of the heat, this must be done with long handled tools, making the process both awkward and tedious, as well as expensive, as it necessarily delays the operation of the furnace. All this is obviated by the use of the Johnson arch plate, and the repairing greatly facilitated.

This arch plate also serves as a form on which the arch can be quickly relaid, supporting the arch during construction. The flange acts as a stop for the bricks in laying the arch.

The Johnson arch plate is made of cast steel, and hence is a permanent appliance which can be utilized on short notice, so that work which would ordinarily require hours in the old way, can, by using it, be done in a small fraction of the time, while the charge of steel is being melted down, and without any delay to the furnace.

The Wellman-Seaver-Morgan Company, of Cleveland, who are the sole manufacturers of the Johnson patent arch plate, publish bulletins giving full details of its performance in actual use, and will be glad to send the same to all inquirers, free of charge.



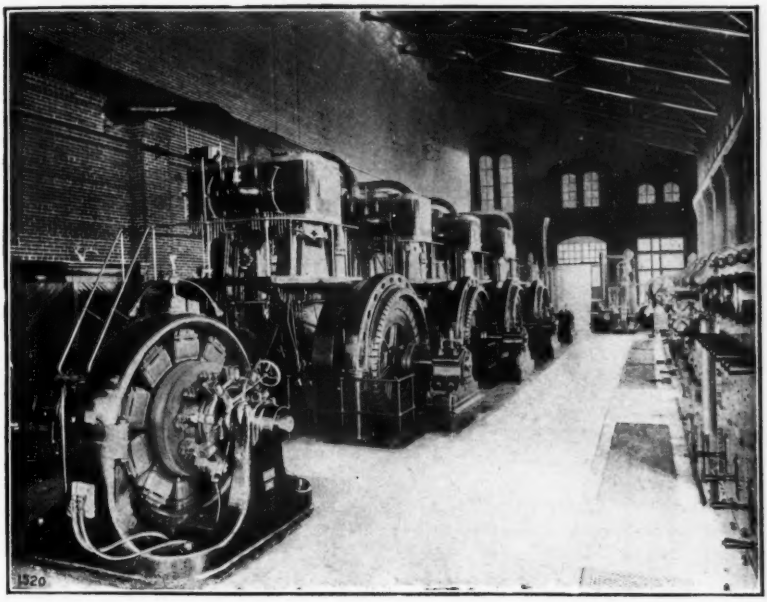
JOHNSON ARCH PLATE.

Compressed Air Plant at St. Louis.

THE compressed air power plant at the Union Terminal Station at St. Louis is of note because of the diversity and extent of the applications of air power. It is a good example of the central compressed air-power plant—the fruit of the present tendency towards centralization of power.

The compressing plant proper is in the main power house of the terminal and consists of two duplex steam-driven two-stage air compressors built by the Ingersoll-Sergeant Drill Company, New York, of the type known as Class "GC." The power of each compressor is about 350 horse power, and at the rated speed of 100 revolutions per minute the free air capacity of each unit is 2,180 cubic feet per minute. The steam pressure applied is 150 pounds and air is delivered to the center of distribution at a pressure of 85 pounds. The steam cylinders of the compressors are 18 inches in diameter; air cylinders 32¼ and 20¼ inches in diameter; the stroke is 24 inches. The machines run non-condensing and a distinctive feature is the piston inlet valve which is applied on both high- and low-pressure air cylinders.

Cool air is led to the compressors from outside the engine room through a supply conduit and the air discharge is delivered to twin receivers in a cooling house or tower outside the main building. The air from these primary receivers passes through a system of secondary receivers, headers and cooling tubes, which reduces the tem-



ENGINE ROOM IN THE POWER PLANT OF THE ST. LOUIS RAILWAY TERMINAL STATION.

perature to that of the outside air and condenses all moisture, which collects in the receivers and is removed through drain cocks. The perfection of the cooling and drying process will be appreciated when it it stated that only once or twice in the most extreme weather has it been necessary to inject alcohol into the air pipes to prevent freezing of the delicate valve mechanisms of the switch and signal system.

The applications of the air power are those common to all railway, shop and yard service. From the cooling house, which is the center of distribution, five main pipe lines radiate. The distances to which power is transmitted range from 1,800 to 5,000 feet; five distinct yards being served from this central plant.

Among the applications of the air may be mentioned the following: pneumatic tools, hoists and jacks in the various shops and yards; charging the brake reservoirs of stationary trains; cleaning cars and car fittings; pneumatic dispatch tube systems; the operation of air engines for a variety of purposes, among them direct connected generating sets supplying current for the electric signal system; Shone ejectors or displacement pumps handling the seepage water in the terminal subway; direct-acting bilge pumps in the accumulator pit of the hydraulic elevator system; and a pneumatic switch and signal system controlling the train movements of the entire terminal organization.

The electro-pneumatic switch and signal system was installed by the Union Switch & Signal Company and its extent will be realized when it it said that during the Exposition traffic the number of trains handled each day in the terminal averaged between 500 and 550, aggregating 2,000 to 2,500 cars. This means the passenger traffic only, and does not include the freight service which passes over the terminal trackage. At the main terminal station alone the number of signals is 284, the number of switches 157, and the number of bridges 20. In addition there are in the Fourteenth Street, Twenty-third Street and Grand Avenue yards probably an equal number of switch and signal appliances.

Northern Motors in Paper-Mill Work.

NOTABLE among the numerous electrically driven paper mills now operating in the United States is the plant of the Consolidated Water Power and Paper Company, of Grand Rapids, Wis. Chief interest centers, of course, in the big variable-speed motors operating the paper machines, but there are numerous other individually driven machines in the plant.

Electric motor drive in the plant of the Consolidated Water Power and Paper Company is a business proposition, pure and simple. With the abundance of power at hand the company could afford to stand the losses of power transmission due to all-belt transmission. Convenience was an important factor in the planning of the mill, the designer holding forth for the constant economies obtained by the convenient arrangement of machines and departments to secure reduction in labor costs. The mill is laid out on modern lines, the raw material entering the plant at its upper end, and emerging at the shipping platform at the lower end.

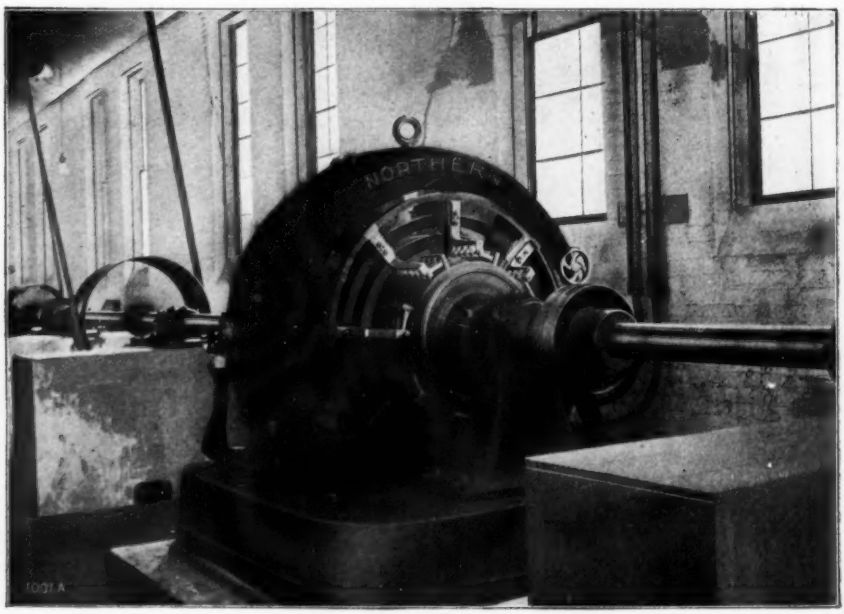
All conveyors, barking and "wet" machines, Fourdriniers, fans, and the machine shop are direct connected to motors. The grinders, heaters and Jordans, however, are arranged on the turbine shafts.

This plant is a decided triumph for direct-current motor drive in paper-mill work. The dynamos and motors installed are potent factors in an increase of output, owing largely to the convenience of operation secured.

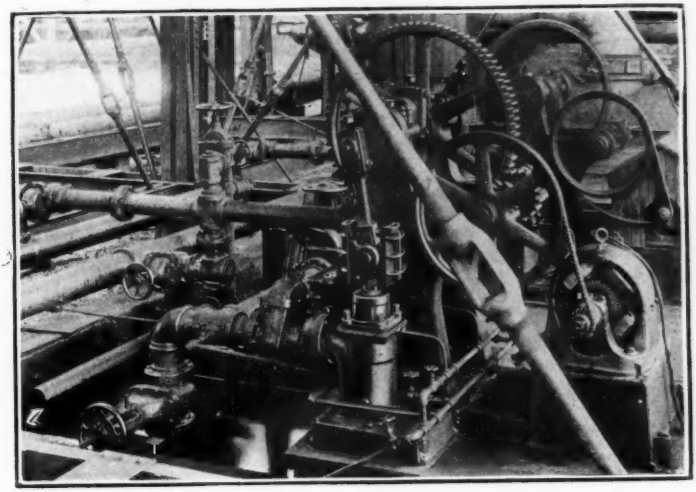
Further information regarding this very interesting installation will be furnished by the Northern Electrical Manufacturing Co., Madison, Wis.

Pumping Tar and Other Heavy Liquids.

IN many industries it is necessary to force heavy, viscous liquids through pipes. This involves difficulties not encountered in ordinary pumping, and requires machinery of special design and construction. When the liquid is heavy but not adhesive, as in the case of heavy oils, the action can be made fairly satisfactory and efficient by



NORTHERN MOTOR ON LINE SHAFT IN A PAPER MILL.



PUMP FOR TAR OR OTHER HEAVY LIQUIDS.

enlarging the valve openings, making the parts of the pump heavier, and so arranging the passages of the pump that there is little liability of choking or clogging. When, however, the liquid is a fluid at high temperatures, but becomes a gelatinous adhesive paste or a rubbery solid, clinging to all surfaces and choking openings through which it should pass, as the temperature is lowered, a design differing materially from the ordinary pump must be used.

Gas tar has a number of characteristics rendering it exceptionally difficult to pump. Its condition varies from a solid to a penetrating fluid within a small range of temperature. Two pumps which have proved very efficient in lifting and forcing gas tar were installed a short time ago at the plant of the Maryland Steel Co., of Sparrows Point, Md. One of the illustrations shows the pumps in position, the one in the foreground being idle and the one in the background working under its normal load. They were built by the Deane Steam Pump Co., of Holyoke, Mass., and are of the standard triplex type of that company, fitted with ball valves peculiarly adapted to this service. The exclusive use of gate valves in the piping system is also interesting. A very flexible power connection is obtained by the use of the Renold silent chain and a four-pole, alternating-current, 3-horse-power motor. The gearing consists of an 18-tooth pinion running at 950 revolutions per minute and a 120-tooth wheel running at 142 revolutions per minute. The chain used has links ¾ inches wide and 1½ inches long. It transmits the 3 horse power generated at 950 feet per minute, giving an excellent efficiency when the service is considered.

A liquid peculiarly difficult to handle is oil-refinery tar, which is usually very hot when it reaches the pump. There is a large percentage of suspended particles of various sizes present in this tar and also a certain amount of unrefined paraffin. The tar is sometimes heated to a temperature of 300 degrees; but quickly cools off if not properly handled, and coats the retaining valves and walls with layers of an adhesive substance closely resembling finely divided particles of coke. To overcome the difficulties the ordinary pump arrangement and design is materially changed.

Another illustration shows a specially designed pump installed by the Deane Company for handling oil-refinery tar at the works of the Atlantic Refining Co., in Philadelphia. By a new arrangement, exceptionally large valve areas are made available, the valves being designed to permit the passage of the substance pumped with the least possible frictional resistance. The

suction, discharge and pulsation chambers can be taken apart without unnecessary expenditure of time or labor, and each is in a position where it can be readily reached for cleaning. The pump is of the triplex type, as shown in the illustration, and is fitted with ball valves, which thorough test has proved best adapted for the passage of heavy substances. There are a number of large hand holes for cleaning the valves. The illustration shows the rigid cross-head guide system and the strong design of the chambers, rods, pistons and bearings.

Machinery which will pump these adhesive oils and other similar substances can be used in many industries, and will save the laborious processes by which this class of work is generally accomplished.

Further particulars regarding this pumping machinery will be furnished on request, by the Deane Steam Pump Co., of Holyoke, Mass.

The Measurement of the Gases.

TWO pyrometers worthy of attention have recently been put on the market. They are the Queen mercurial pyrometer and the Queen electrical pyrometer, constructed by Queen & Co., Philadelphia, for measuring the temperatures of flue gases, although they are made in such convenient forms that they will measure accurately any temperatures that come within their ranges.

The makers claim that by a special process in the manufacture of the mercurial pyrometer they have eliminated any possible change of the scale from constant use at high temperatures. This form of pyrometer will measure all flue gases up to 1,000° Fahrenheit, and owing to its sensitiveness it is much more desirable than the old form of metallic pyrometer.

The proper regulation of the temperature of flue gases by means of the pyrometer will cause a saving in the coal bill of at least ten per cent. Another application to which the pyrometer is put is its use for measuring and regulating the temperatures in core ovens. Few realize how much better results are obtained when cores are baked at a proper and uniform temperature.

For temperatures over 1,000° Fahrenheit an electrical pyrometer is used. The Queen pyrometer will measure up to the fusing point of platinum, 3,200° Fahrenheit. The feature of this pyrometer is that it will record the temperatures at a distance,, so that the chief engineer may sit at his desk and read the temperatures of the stack.

The Queen electrical pyrometer involves the same principles as the Le Chatelier pyrometer: that is, the measurement, by a very sensitive d'Arsonval galvanometer, of the current of electricity generated when the junction of a thermo-electric couple is heated. The galvanometer, or pyrometer proper, is in reality a millivoltmeter, absolutely dead beat, arranged in a portable form for carrying from place to place.

The thermo-electric couple consists of one platinum wire and one platinum rhodium wire fused together and protected by suitable porcelain and iron tubes. It is connected to the pyrometer by two ordinary insulated wires, no batteries being used. The pyrometer is of such high internal resistance, that any change in the length or temperature of the connection has no appreciable effect on the reading.

A feature of the pyrometer is its portability; it can safely be carried or shipped with only ordinary precaution. Its accuracy is guaranteed by the manufacturers to be within one per cent. and not to change with constant use.

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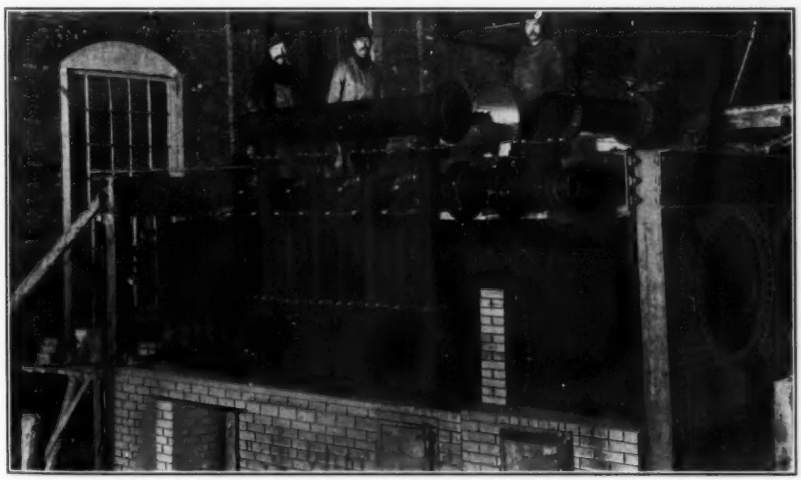
Protection of Steam Superheaters.

A SOURCE of expense in the operation of superheaters, when placed in the direct path of the products of combustion, is the burning of the superheater tubes. Hitherto the methods employed to overcome this have been the protection of the tubes by flooding with water, or by diverting the hot gases by means of dampers. The practice of flooding with water is questionable on account of the impurities in the water, more generally existing than not, which will scale up the tubes. Superheater tubes cannot be cleaned as is the case with boiler tubes, and it is therefore only a question of time when the coating of scale will be thick enough to cause overheating and consequent damage. Another objection to the use of water is the skill required to be exercised in flooding and draining at the right time to avoid water hammer. As regards the use of dampers, they are exposed to great heat and will become warped and inoperative. A third method has lately been devised—overcoming these objections and raising no others—by means of which the superheater tubes attached to any one boiler are supplied with saturated steam from the other boilers for the purpose of protecting the tubes when raising steam, or should a part of a battery be suddenly shut down for any reason. This is accomplished by running an auxiliary steam main connecting with the steam space of each boiler and the inlet header of each superheater. By this means a constant circulation of saturated steam flows through every superheater, is superheated, and passes into the superheated steam main. When fires are drawn



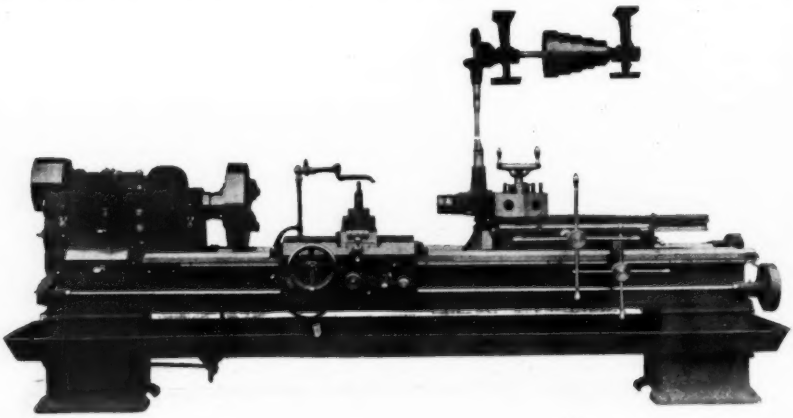
POTTER PROTECTION FOR SUPERHEATER TUBES.

from any boiler the circulation of steam through the superheater attached thereto is stopped by closing a valve on the branch from the auxiliary main to the inlet header of that superheater. By this means the superheater tubes will remain clean, they cannot scale up any more than a line of steam pipe, and the operation is extremely simple, entailing as it does the opening of one valve in the auxiliary pipe to the boiler being brought into service as soon as the superheater tubes are warmed up sufficiently to prevent condensation. This valve should remain open until the fires are again drawn from that boiler.

This system, which can be applied to any make of superheater that is directly attached to a boiler, entails very little additional expense, as the auxiliary main can be used also for pumps, etc., which are not usually designed for superheated steam. Further information will be gladly furnished to anyone interested by The Potter Separator Co., 39 Cortlandt St., New York, who are manufacturers of steam superheaters and other steam specialties.

A Special Boring Lathe.

THE accompanying illustration presents an interesting machine brought through by The American Tool Works Co., Cincinnati,—a 22-inch "American" lathe with patent all geared head, pan, oil pump, turret, and special boring device. The entire screw cutting mechanism has been omitted on this machine, inasmuch as the lathe is primarily intended for roughing and boring, and the feeding mechanism, while of the same principle as that regularly incorporated on the "American" lathes, is of a special nature. There are seven carriage feeds, ranging from .2 to .015, being scientifically graded for the greatest efficiency in that character of roughing and boring planned for this lathe by the customer. The geared head is of extremely simple powerful and efficient construction. Only six gears are required to obtain four speeds through levers shown on the front. This simplicity of construction enables the gears to be made of very wide face, and large diameters, thus giving the entire mechanism sufficient strength to transmit the maximum power delivered to the machine by a six-inch double belt. The four speeds obtainable through the head, in connection with a triple friction countershaft, supply twelve distinct speeds to the spindle, ranging from 5 to 322 revolutions per minute.



A SPECIAL BORING LATHE.

The carriage is fitted with plain block rest, which is provided with an interesting calipering attachment. This consists of a set of four adjusting screws, attached to the plain block rest after the manner of

eyebolts, each one falling, when desired, over into corresponding slots in the yoke piece over the front carriage dovetail. By adjusting knurled locknuts on any of the four screws and dropping same into the slot, the travel of the cutting tool toward the center, and hence the diameter to be turned, is limited at pleasure. This attachment is very valuable in duplicate work, as adjustments can be made for duplicate turning of pieces with four shoulders.

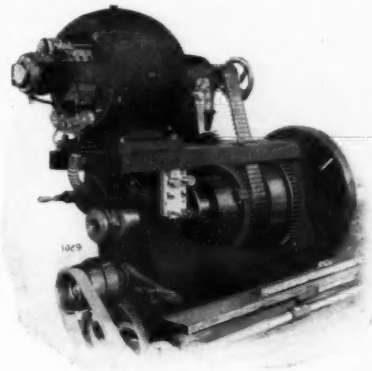
The hexagon automatic turret is of liberal size, with rapid and easy adjustments. It is provided with power feed, driven by sprocket chain from the feed rod, thus giving fourteen feeds to the turret, ranging from .16 to .007. The worm is dropped out of mesh with the wheel by an improved tripping device, adjustable at will from the front of the machine.

The turret slide has extra long bearing on the bed; the top slide has 24-inch movement, controlled by pilot wheel, and is supported on the front end by an improved supporting shoe, which slides on the ways, and is firmly bolted to the end of the turret slide directly under the cutting tool. It insures accurate alignment in boring, and has gibbed bearing both at the top and bottom of ways, thus preventing all spring in any direction.

The drilling attachment is affixed to one of the faces of the turret, and is extremely valuable in boring operations. It consists of a symmetrical housing carrying miter gears which actuate a spindle with ball-bearing thrust, which carries the boring bar. The spindle is made to revolve from a separate overhead countershaft, as shown in the illustration, by means of universal joints connected by a telescopic rod, which thus compensates for any movement of the turret slide. The boring spindle revolves in the opposite direction to the main spindle on the head, an obvious advantage. The boring spindle has five rates of speed through the cone pulley on the countershaft giving proper gradation to obtain the best results in the boring for which the lathe is intended. Whenever it is desired to use another face of the turret, it may be revolved without disturbing the drilling attachment, due to the telescopic rod. The boring tool is provided with oil supply, the same being drawn by an auxiliary pump up through the turret stem and boring bar. The carriage has a similar oil supply to the turning tool. The pan beneath the bed catches all waste oil, which is returned to the machine repeatedly. The lathe is very heavy and substantial throughout, to adapt it to the unusually heavy strains which a lathe of this character must undergo. Further information will be cheerfully furnished by the makers.

Changing to Motor Drive.

TO enable owners of belted machine tools to apply electric motor drive to their old equipment the Northern Electrical Manufacturing Company, Madison, Wis., has developed a multi-speed motor. The object is to provide a combination of electrical and



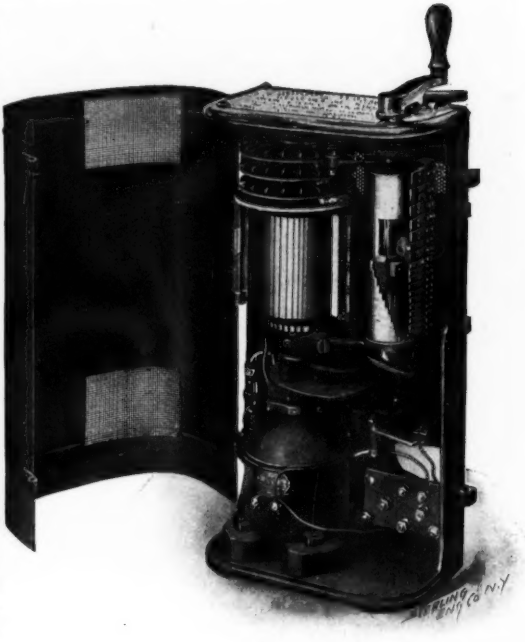
A LATHE CHANGED TO MOTOR DRIVE.

mechanical speed variation to secure a compact, self-contained unit which can be applied to the machine with but little change and at slight expense.

This motor combines a Northern single voltage variable-speed motor of appropriate variation with a change gear box which supplements the motor variations. The application of the motor is very simple, and our illustration shows a representative drive accomplished by the use of this mechanism. The lathe headstock shown is that of an old Blaisdell engine lathe which was about to be discarded because it could not compete in productiveness with modern motor-driven machine tools. To accomplish the change the only alteration made in the ma-

chine was to remove the spindle-bearing caps. A simple saddle was designed to span the cone, to provide a support for the motor. The saddle replaces the bearing caps. The illustration clearly shows the method of drive. The cone was retained, and in order to apply a chain transmission a split gear was applied to the third pulley. This was driven from the armature pinion by means of silent chain.

The Northern multi-speed motor enables machine-shop owners to put belted machine tools on a money-making basis, and makes it possible for them to compete with plants employing new motor-driven machine tools. The multi-speed motor affords an opportunity for machine-shop owners to demonstrate for themselves the advantages of individual motor-drive by applying it to some old lathe or other machine tool. The advantage of the Northern system is that the multi-speed motor can be operated from any ordinary two-wire single-voltage power circuit, and electrical variations as high as 5 to 1 easily secured. Where a 5 to 1 electrical variation is accomplished the change gear enables a total variation of 15 to 1. Bulletin No. 454 is descriptive of the multi-speed motor, and will be sent on request.



ELECTRIC MOTOR CONTROLLER.

Electric Motor Control.

THE Rheocrat, shown herewith in half-tone, is designed to control the speed of electric motors, especially in the direct driving of machine tools and other machinery. The advantages claimed for this device are wide and minute range of speed; uniform gradation of speeds; maintenance of motor speeds at all loads when adjusted to any given speed; maintaining of constant torque; economy of operation; adaptability to shop plants without extra wiring and additional generator sets; adaptability to standard designs of motors and machines already in use; ability to stand abuse under severe usage; and low cost of maintenance.

These important advantages are attained by new principles. Instead of introducing resistance in the armature circuit, a simple device makes and breaks the circuit, and the relative change between make and break which determines the amount of impressed electromotive force on the armature constitutes a voltage control through wide range, giving minute changes of speed.

The Rheocrat permits of a range of speeds 3½—1 to 5—1 depending in a measure on the field range of motor. This may, in special cases, be extended to even 10 or 12 to 1. One of the strong points claimed for the Rheocrat is that there is no jump from one speed to another, but a gradual acceleration or diminution of speed between the limits of the armature control; on the other hand any desired gradation in field control can be obtained in addition.

Doubtless the greatest of all objections heretofore advanced against the system of armature control is the fact that at a given

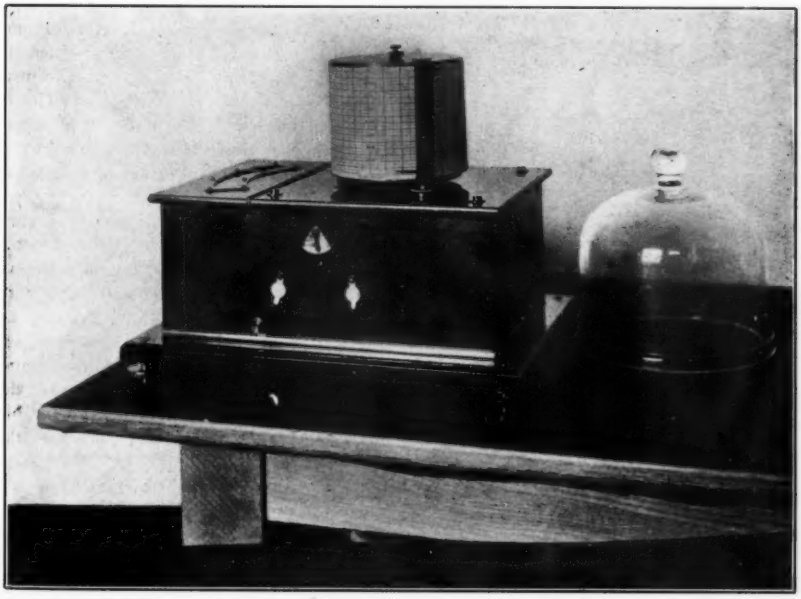
speed, especially at a slow speed when a large amount of resistance has necessarily been interposed in the circuit, the speed varies widely under different loads. The Rheocrat, using no resistance, allows the motor to maintain practically constant speed under varying loads.

The manufacturers of the Rheocrat, American Electric and Controller Co., 12 Dey Street, New York, have issued a descriptive bulletin giving many details and the results of a practical demonstration of the device. It will be sent to inquirers on request.

Instantaneous Record of High Temperatures.

A VALUABLE addition to the recording instruments made by Queen & Co., Inc., Philadelphia, is their new recording pyrometer for high temperatures. It is adapted to give a continuous record of temperatures up to 3,000° Fahrenheit. The galvanometer, especially designed for this purpose, is of the d'Arsonval type, and besides presenting the important feature of extreme sensitiveness, is absolutely dead beat. It is, moreover, not in the least affected by vibrations. The recorder is so arranged, that the pen traces on a chart the exact movements of the galvanometer pointer. In the clock which rotates the recording cylinder once in every twenty-four hours, an electric contact is made every minute, whereby an electro-magnet is energized which clamps the pointer of the galvanometer. This, is turn, operates a relay, causing the pen to move up and down until it coincides with the reading of the galvanometer. The pointer then swings entirely free until the next contact is made. The recording device in no way impairs the accuracy or sensibility of the pyrometer. The thermo-electric couple consists of platinum and platinum-rhodium wires three feet long, enclosed in a porcelain protecting tube. Any desired length of wire will, however, be furnished. The indicating instrument is graduated in millivolts and in degrees of temperature.

That the new Queen recording pyrometer is portable, and it gives a continuous record for the whole twenty-four hours, are points

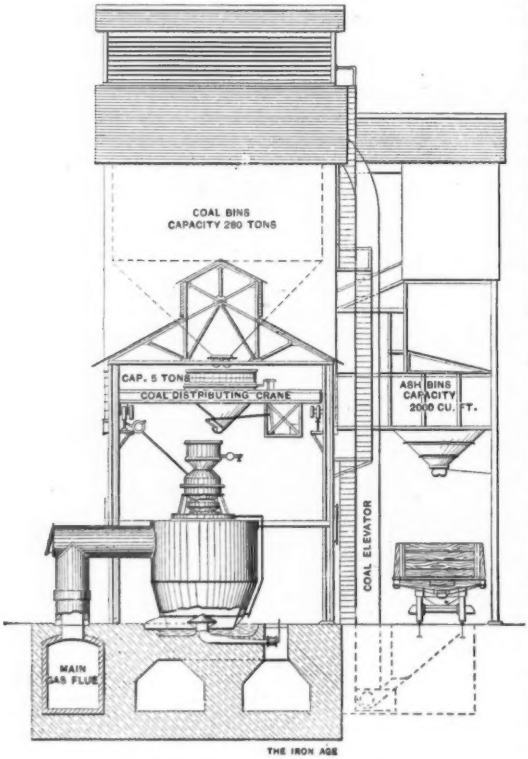


QUEEN RECORDING PYROMETER.

of too great importance to be overlooked. The makers Queen & Co., will furnish details of this and other pyrometers, upon request.

Coaling Gas Producers.

TO provide the most efficient means for coaling a battery of gas producers is sometimes the most serious problem connected with their installation, especially if the plant consists of six or more units. The usual method employed is to build one long overhead bin or a series of smaller bins from which the coal is drawn through spouts at each producer. This plan presents the following objectionable features: (1) Coal at any given part of the bins can only be used in the producer over which it rests; (2) the cost of construction of the bins distributed over a large battery of producers is high; (3) expensive machinery must be employed to distribute the coal over the entire length of the bin, and unless this machinery is in duplicate there is risk of the coal supply running short; and, (4) daily records of coal used cannot be kept, nor can the amount charged to individual producers be ascertained.



SYSTEM OF COALING GAS PRODUCERS.

These difficulties have been avoided in the arrangement recently installed by the Morgan Construction Company, Worcester, Mass., at the plant of the Lackawanna Steel Company in Buffalo, there being a battery of sixteen ten-foot producers in one line, gasifying 175 tons of bituminous coal per day. The illustration on this page exhibits a cross section of the producer house. The coal is received in hopper bottom dump cars alongside and near the center of the plant. Underneath the railroad track a large steel hopper is provided to receive the coal as it discharges from the cars and deliver it to the boot of a coal elevator. The coal is elevated by means of a simple bucket elevator running vertically only and designed to discharge the coal into a central overhead bin having a capacity of 340 tons. The entire coal supply is carried in this one bin and is distributed to the producers as required by a light traveling car running under the central storage bin and over all the producers. The distributing car or crane carries a fixed hopper of five tons capacity, resting on scales. A boy operator, sitting in the cage of the crane, draws a lever and fills the crane tank from the central storage bin and discharges the coal as needed into the receiving hopper of the producer in lots of 1,000 pounds or less. The crane tank carries 10,000 pounds. The beam of the scale is conveniently located in front of the crane cage, and exact coal records are readily made for each producer. The arrangement of large coal tank and distributing crane makes it possible to utilize the

last pound of coal in any producer of a large battery and any additional gas units can be served without adding to the coal handling machinery, as one crane would be capable of serving about fifty producers.

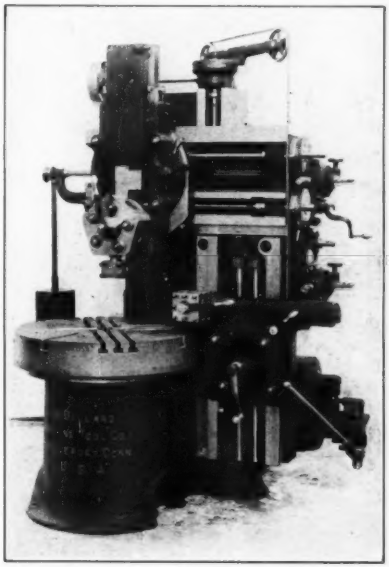
Over the same track on which the coal is received, and within a few feet of where it is dumped from the cars, a large ash reservoir is located, with a capacity of 2,000 cubic feet. The ashes, which are collected by hand from the bottom of the producer, are deposited in a skip bucket, in which they are elevated to the overhead bin. The ashes are taken away in the same cars in which the coal is brought to the plant, thus saving a switch for each car of ashes removed. The entire equipment was built by Morgan Construction Company, Worcester, Mass., from its own designs.

The Vertical Lathe.

FOR the purpose of handling heavy face-plate work of all descriptions, experience has demonstrated the superiority of the vertical mill over the horizontal face plate lathe. Not only is a more rigid frame, or bed, permissible in the vertical construction, and larger spindle sizes and greater power made possible, but the added weight of the work resting directly on the spindle thrust bearing tends to preserve, rather than to destroy, the alignment. There is also an obvious freedom from chatter and vibration in the vertical type, as compared with the horizontal, which can be readily appreciated when the heavy overhanging parts of the latter are considered. This very point of overhang is one of the strongest arguments in favor of the mill, as the time which in the lathe is consumed in setting a heavy overhanging piece is, in the mill, added to the actual time in which the machine can be cutting.

In the horizontal turret machine are usually combined a turret slide, having a longitudinal movement only, and an ordinary lathe carriage. The latter, in many instances, interferes with the proper operation of the turret, and renders necessary the use of long, unsupported boring bars and extended tool holders. The turret, having no cross movement, is of value in a limited field only, and requires an equipment of special tools which, in many cases, result in no saving in time. Taper boring, except with special equipment, is practically impossible in the horizontal turret lathe, and thus the range of the machine is considerably abridged.

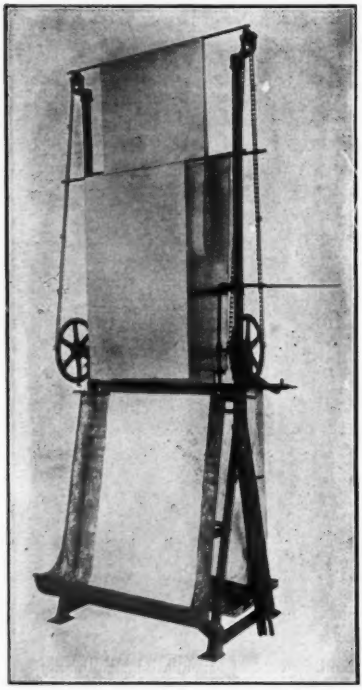
The design of the Bullard vertical turret lathe includes features heretofore found only in the horizontal type, improved upon and incorporated with the most advantageous points of the vertical construction



A VERTICAL LATHE.

dictated by an experience of more than twenty years in the manufacture of vertical boring and turning mills. The result is a universal manufacturing machine in which several desirable features are noticeable: The vertical construction, with its large spindle and great power, and ease and rapidity of chucking heavy work; a turret slide which is rigid and powerful, having both cross and vertical feeds, and which may be swiveled to 45 degrees either side of the center for taper boring and turning; a side head, carrying a four-faced turret tool holder, which not only has all the advantages which are conceded to the carriage of the horizontal machine,

including vertical and cross feeds, but may be swiveled for angular facing up to 40 degrees either side of the horizontal; a driving mechanism, which is the result of considerable experiment and includes an exceptionally efficient mechanical speed change, operable by lever at front of tool, from which are derived fifteen geometrically progressive table speeds; feed works, independent for either head, having eight



BLUE PRINT WASHER.

feeds, any one of which may be instantly obtained by turning the star wheel to the proper point on direct reading index plates. Pull gears on feed rods have been entirely eliminated, worm gears, keyed to the rods, having superseded them. Changes from cross to vertical feed, or vice versa, are made by engaging a centrally located drop worm. Safety points have been so arranged in the feeds that carelessly permitting the heads to run together results in no damage or delay. Both heads may be operated jointly on work of small diameter without interference—this feature presenting the greatest advantage in the machine, and resulting in an increase of output.

The Bullard Machine Tool Co., Bridgeport, Conn., will furnish full description and other details to machine-tool men.

Blue Print Washing and Drying Machine.

A NEW blue print washing and drying machine, the Pease, is illustrated herewith. The washing of the prints is accomplished by a spray of running water flowing over the treated side of the paper only, removing the surplus ferroprussiate in the quickest time possible. Prints are not soaked through as in the old process, as the water coming in contact with one side of the paper only and for but a very short time, leaves it in a condition to dry in about one-third of the time usually required. The delivery therefore is greatly expedited.

The print is placed on the drying rod before washing and remains there during the entire process of washing, wiping and drying, making it unnecessary for the operator to wet his hands. He can, therefore, work to and from printer and washer without difficulty, washing sheets as fast as printed, as the time required at the machine is but a fraction of a minute. As it hangs in the washing tray on the drying rod, the water flows down both sides of the doubled print, half of it on the side toward the operator and the rest between the print and the back of the tray. When the front portion of the print in view of the operator is completely washed the balance is always in the same condition.

The surplus water is removed by a device which wipes the print as it is moved upward out of the way on the drying chains. As the next print is pulled through the wiping device the previous one is carried still higher and over the top, and finally downward until it is automatically stripped from the chains of the machine, falling into a drying rack from which the dry prints may be removed as required.

The manufacturer is C. F. Pease, 175 West Locust Street, Columbus, Ohio, who will furnish fuller details on request.

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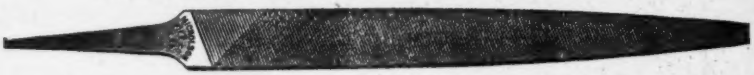

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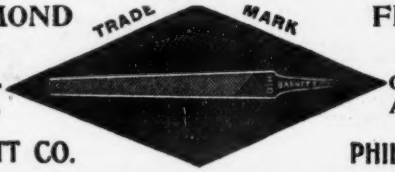

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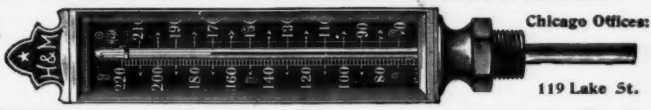

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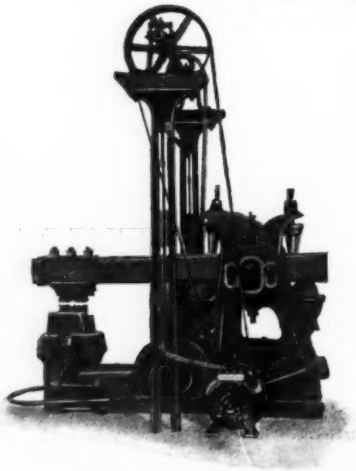

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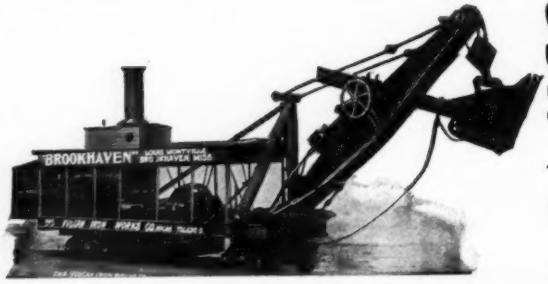

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LUCIEN PÉRISSÉ (*The Latest Types of Automobile Vehicles*)—Graduate of the Ecole Centrale des Arts et Manufactures (1891); for two years was attached to the staff of the chief engineer of the Canadian Pacific Railway, and under his direction superintended the construction of steel bridges at various points along the line; was delegate of the Société des Ingenieurs Civils de France to the Chicago Exposition; author of the volume upon "Automobiles on Common Roads" in the Léauté encyclopedia; associate editor of *La Nature*, of *Génie Civil*, etc., and secretary of the technical commission of the Automobile Club of France. Consulting engineer in Paris, devoting his attention principally to automobiles, gas and petroleum motors, and to the construction of workshops. Author of the second volume of the Léauté encyclopedia—"Carburettors"—published in 1904. Chevalier de la Legion d'Honneur, October, 1904.

H. L. ARNOLD (*Stores-Room Methods of the Pond Machine-Tool Works*)—Born near Rochester, N. Y., June 27, 1837; worked as a journeyman machinist in western river and lake engine shops and R. I. R. R. shops for twelve years; subsequently superintendent Ottawa Machine Shops and Foundry, Ottawa, Ill., designer and department foreman for E. W. Bliss, Brooklyn, N. Y., superintendent for Stiles and Parker Press Company, Middletown, Conn., and designer for Pratt and Whitney Company, Hartford, Conn.; author of "The Complete Cost-Keeper" (THE ENGINEERING MAGAZINE Press, Ltd.) and "The Factory Manager and Accountant" (THE ENGINEERING MAGAZINE) and a frequent, able, and acceptable contributor to publications devoted to the technical and commercial aspects of mechanics.

ROBERT M. NEILSON (*The Superheating of Steam, and its Influence on Engine Economy*)—Born Dumfries, Scotland, 1874; educated in Dumfries Academy and the Glasgow and West of Scotland

Technical College and the University of Glasgow; served his time from 1891 to 1896; from 1896 to 1899 was chief assistant to W. T. Rowden, B. Sc., A. R. S. M., professor of applied mechanics at the Glasgow and West of Scotland Technical College; spent the summer of 1897 in the works of Messrs. Wm. Beardmore & Co., and the summer of 1898 in the works of Messrs. Babcock & Wilcox; since 1899 has been assistant to Mr. Dugald Clerk and since 1900 manager of the Manchester office of Messrs. Marks & Clerk; as a student under Lord Kelvin he took great interest in the study of the flow and momentum of liquids; is author of "The Steam Turbine."

FREDERICK VALDEMAR HENSHAW (*A Discussion of Systems of Power Supply for Mine Work*)—Born 1868, Brooklyn, N. Y. Educated at High School and Bishop's College, Montreal, Canada; rodman and assistant on survey on St. Lawrence River, 1886; apprentice, draughtsman, and assistant to chief engineer, Royal Electric Co., Montreal, until 1889; assistant engineer and designer The C & C Electric Motor Co., New York; consulting engineer of firm of Downes & Henshaw, Providence, R. I., 1895-1897, designing power plants, making expert tests, etc.; from 1897 until 1904 with Crocker-Wheeler Co., Ampere, N. J., in charge of estimating, outside construction, and a large part of designing and factory management; has devoted much attention to the application of electric power to industrial works. Member American Society Mechanical Engineers and American Institute of Electrical Engineers.

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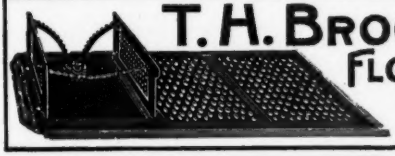

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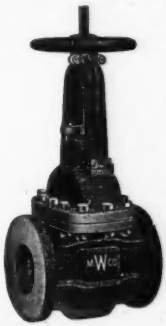

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The Buyers' Directory

OF

THE ENGINEERING AND MACHINERY TRADES

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index.* *See page 11.*

Advertising.
Manufacturers Adv. Bureau, N. Y.

Accountants and Auditors.
Everett Audit Co., Chicago.
Gunn, Richards & Co., 41 Wall St.,

Accumulators, Hydraulic.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.
Henry R. Worthington, New York.

Aerial Tramways.
Broderick & Bascom Rope Co., St. Louis.
A. Leschen & Sons Rope Co., St. Louis.
Lidgerwood Mfg. Co., New York.
Trenton Iron Co., Trenton, N. J.

Air and Gas Compressors.
Allis-Chalmers Co., Chicago.
Am. Air Compressor Wks., New York.
Amer. Well Works, Aurora, Ill.
Geo. F. Blake Mfg. Co., New York.
Clayton Air-Compress. Wks., N. Y.
Contractors' Supply & Eqpt. Co., Chicago.
Curtis & Co. Mfg. Co., St. Louis.
Deane Steam Pump Co., New York.
Hall Steam Pump Co., Pittsburg.
Hanna Eng'ng Works, Chicago.
Ingersoll-Sergeant Drill Co., N. Y.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
P. B. McCabe & Co., Los Angeles.
John H. McGowan Co., Cincinnati.
Norwalk Iron Works, South Norwalk, Conn.
Pneumatic Engineering Co., N. Y.
Providence Eng. Wks., Providence.
Rand Drill Co., New York.
Snow Steam Pump Wks., New York.
Union Steam Pump Co., Battle Creek, Mich.
Vulcan Iron Wks., Wilkesbarre, Pa.
Henry R. Worthington, New York.

Air Brakes.
National Electric Co., Milwaukee.
Westinghouse Air Brake Co., Pittsburg.

Air Drills.
Amer. Air Compressor Works, N. Y.
Chicago Pneumatic Tool Co., Chicago.
Clayton Air Compressor Works, N. Y.
Ingersoll-Sergeant Drill Co., N. Y.

Air Hoists.
Amer. Air Compressor Works, N. Y.
Chicago Pneumatic Tool Co., Chicago.
Geo. F. Blake Mfg. Co., New York.
Curtis & Co. Mfg. Co., St. Louis.
Gen. Pneumatic Tool Co., Montour Falls, N. Y.
Hall Steam Pump Co., Pittsburg.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., N. Y.
Pneumatic Engineering Co., N. Y.

Air Motors.
Amer. Air Compressor Works, N. Y.

Alumino-Thermics.
Goldschmidt Thermit Co., New York.

Ammeters.
Weston Elec. Inst., Co., Waverly Pk., N. J.

Angle Bars and Splices.
Continuous Rail Joint Co., Newark.

Anti-Friction Metals.
Phosphor Bronze Smelting Co., Phila.
Poole Eng. & Mch. Co., Baltimore.

Automatic Time Stamps.
Perry Time Stamp Co., Chicago.

Automobile Drop Forgings.
Chicago Drop Forge & Foundry Co., Kensington, Ill.

Ballast Unloaders.
Broderick & Bascom Rope Co., St. Louis.
A. Leschen & Sons Rope Co., St. Louis.
Marion Steam Shovel Co., Marion, O.

Ball Bearings.
American Ball Co., Providence.
Ball Bearing Co., Philadelphia.
Hess-Bright Co., Philadelphia.

Ballcocks.
Julian D'Este Company, Boston.

Band Saws.
Fay & Egan, Cincinnati.
Frank Machinery Co., Buffalo.

Belt Conveyors.
Ridgway Belt Conveyor Co., N. Y.
Robins Conveying Belt Co., New York.
Webster Mfg. Co., Chicago.

Belt Dressing (Waterproof).
Jos. Dixon Crucible Co., Jersey City.

Belting.
Boston Belting Co., Boston.
Eureka Fire Hose Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Engineering Co., Phila.
Pittsburg Gage & Supply Co., Pittsburg.
Ridgway Belt Conveyor Co., N. Y.
Robins Conveying Belt Co., N. Y.

Belt Lacing.
Bristol Co., Waterbury, Conn.

Belt Lacing Machines.
Diamond Drill & Mch. Co., Birdsboro, Pa.

Bending Rolls.
Bethlehem Fdy. & Mch. Co., So. Bethlehem, Pa.
Niagara Mch. & Tool Wks., Buffalo.
Niles-Bement-Pond Co., New York.
William Sellers Co., Inc., Phila.

Blast Furnaces.
Chicago Flexible Shaft Co., Chicago.
Walter Kennedy, Pittsburg.
G. W. McClure, Son & Co., Pittsburg.
Riter-Conley Mfg. Co., Pittsburg.
Wellman-Seaver-Morgan Co., Cleveland.

Blocks, Tackle.
A. Leschen & Sons Rope Co., St. Louis.

Blowers.
American Blower Co., Detroit.
American Gas Furnace Co., N. Y.
Green Fuel Economizer Co., Matteawan, N. Y.
J. D. Smith Fdy. Supply Co., Cleveland.
Sprague Electric Co., New York.
B. F. Sturtevant Co., Boston.

Blue Prints.
Kolesch & Co., New York.

Blue Print Machinery.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.
Pittsburg Blue Print Co., Pittsburg.
Spaulding Print Paper Co., Boston.

Boiler Compounds.
John Simmons Co., New York.

Boiler Fronts and Fittings.
Mecklenburg Iron Wks., Charlotte, N. C.
John Simmons Co., New York.
Vulcan Iron Wks., Toledo.
Walworth Mfg. Co., Boston.

Boiler Inspectors.
Hartford S. B. I. & Ins. Co., Hartford.

Boiler-Makers' Tools.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Stow Flexible Shaft Co., Phila.

Boilers.
Allis-Chalmers Co., Chicago.
American Well Wks., Aurora, Ill.
Atlantic Works, East Boston, Mass.
Atlas Engine Works, Indianapolis.
Babcock & Wilcox Co., New York.
Contractors' Supply & Eqpt. Co., Chicago.
Fitzgibbons Boiler Co., Oswego, N. Y.
Harrison Safety Boiler Wks., Phila.
Heine Safety Boiler Co., St. Louis.
Kingsford Fdy. & Mch. Co., Oswego, N. Y.
P. B. McCabe & Co., Los Angeles, Cal.
Riter-Conley Mfg. Co., Pittsburg.
Robb-Mumford Boiler Co., Boston.
Struthers-Wells Co., Warren, Pa.
Tippett & Wood, Phillipsburg, Pa.
Titusville Iron Co., New York.
Robt. Wetherill & Co., Chester, Pa.
Wickes Bros., Saginaw, Mich.

Bolt and Nut Machinery.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.

Boring Bars.
H. B. Underwood & Co., Phila.

Boring Mills.
American Tool Wks. Co., Cincinnati.
Bullard Mch. Tool Co., Bridgeport, Conn.
Frank Machinery Co., Buffalo.
Niles-Bement-Pond Co., New York.
William Sellers Co., Inc., Phila.

Brakes Friction.
Elec. Controller & Supply Co., Cleveland.

Brass Founders' Supplies.
Geo. F. Blake Mfg. Co., New York.
S. Obermayer Co., Cincinnati.
J. D. Smith Fdy. Supply Co., Cleveland.

Breast Drill, Electric.
Jas. Clark, Jr., & Co., Louisville.

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Brick.
Henry Maurer & Son, New York.
National Pyrogranit Co., New York.

Brick and Tile Machinery.
American Blower Co., Detroit.
Jeffrey Mfg. Co., Columbus.
Vulcan Iron Wks. Co., Toledo.

Bridges, Suspension.
A. Leschen & Sons Rope Co., St. Louis.

Briquetting Machinery.
Am. Briquetting Mch. Co., Pittsburg.

Buckets, Automatic.
Hayward Co., New York.
Russel Wheel & Fdy. Co., Detroit.
Wellman-Seaver-Morgan Co., Cleveland.

Bucket Elevators.
Webster Mfg. Co., Chicago.

Bulldozers.
National Mch. Co., Tiffin, Ohio.
Niles-Bement-Pond Co., New York.

Business Systems.
Everett Audit Co., Chicago.

Cable-Railway Machinery.
Allis-Chalmers Co., Chicago.
A. Leschen & Sons Rope Co., St. Louis.
Poole Eng'g & Mch. Co. ,Baltimore.

Cables, Elec. & Submarine.
General Electric Co., New York.
Sprague Electric Co., New York.

Cableways—Steam and Elec.
Lambert Hoist. Engine Co., Newark.
Lidgerwood Mfg. Co., New York.

Cableways—Wire Rope.
A. Leschen & Sons Rope Co., St. Louis.

Cables, Wire.
Broderick & Bascom Rope Co., St. Louis.
A. Leschen & Sons Rope Co., St. Louis.
Lidgerwood Mfg. Co., New York.
Trenton Iron Co., Trenton, N. J.

Calculating Machines.
Calculagraph Co., New York.
Keuffel & Esser Co., New York.
C. E. Locke Mfg. Co., Kensett, Iowa.

Carborundum.
Carborundum Co., Niagara Falls, N.Y.

Cars.
Continental Car & Eqpt. Co., New York.
Arthur Koppel, New York.
Mecklenburg Iron Wks., Charlotte, N. C.
Russel Wheel & Fdy. Co., Detroit.
Stuebner Iron Wks., Long Isld. City.

Car Shop Machinery.
Fay & Egan Co., Cincinnati.
Frank Machinery Co., Buffalo.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Castings, Iron, Steel & Brass.
Allis-Chalmers Co., Chicago.
Buffalo Foundry Co., Buffalo.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Stanley G. Flagg & Co., Phila.
Goldschmidt Thermit Co., New York.
Hauck Mfg. Co., Cincinnati.
Jeffrey Mfg. Co., Columbus.
Mecklenburg Iron Wks., Charlotte, N. C.
National Electric Co., Milwaukee.
Poole Eng'g & Mch. Co., Baltimore.
Russel Wheel & Fdy. Co., Detroit.
John Simmons Co., New York.
Southwalk Fdy. & Mch. Co., Phila.
Vulcan Iron Wks. Co., Toledo.
Walworth Mfg. Co., Boston.
Wellman-Seaver-Morgan Co., Cleveland.
Robt. Wetherill & Co., Chester, Pa.

Cement Machinery.
Allis-Chalmers Co., Chicago.
Bethlehem Fdy. & Mch. Co., So. Bethlehem, Pa.
H. W. Caldwell & Sons Co., Chicago.
Contractors' Supply & Eqpt. Co., Chicago.
W. D. Dunning, Syracuse, N. Y.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Vulcan Iron Works Co., Toledo.
Wellman-Seaver-Morgan Co., Cleveland.

Cement Portland.
American Cement Co., Phila.
Atlas Portland Cement Co., N. Y.
Kelley Isl. Lime & Trans. Co., Cleveland.

Chain Belting.
H. W. Caldwell & Sons Co., Chicago.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.

Chain Making Machinery.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

Checks, Time, Pay & Trade.
American Ry. Supply Co., New York.
Schwerdtle Stamp Co., Bridgeport.

Chemicals.
Roessler & Hasslacher Chem. Co., New York.

Chucks.
Almond Mfg. Co., Brooklyn.
American Tool & Mch. Co., Boston.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland.

Clocks.
E. Howard Clock Co., Boston.

Clocks, Tower and Office.
E. Howard Clock Co., Boston.

Clocks, Watchman.
E. Howard Clock Co., Boston.

Clutches, Magnetic.
Elec. Controller & Supply Co., Cleveland.

Clutch Puleys.
H. W. Caldwell & Sons Co., Chicago.

Coal and Ashes-Handling
Am. Hoist & Derrick Co., St. Paul.
Broderick & Bascom Rope Co., St. Louis.
Browning Eng'g Co., Cleveland.
H. W. Caldwell & Sons Co., Chicago.
Cortlandt St. Iron Wks., Jersey City.
Hayward Co., New York.
C. W. Hunt Co., New York.
Interstate Eng'g Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Arthur Koppel, New York.
A. Leschen & Sons Rope Co., St. Louis.
Link-Belt Eng'g Co., Phila.
Ridgway Belt Conveyor Co., N. Y.
Robins Conveying Belt Co., N. Y.
Russel Wheel & Fdy. Co., Detroit.
Frank B. Stratford, New York.
Webster Mfg. Co., Chicago.
Wellman-Seaver-Morgan Co., Cleveland.

Coal-Mining Machinery.
Allis-Chalmers Co., Chicago.
Broderick & Bascom Rope Co., St. Louis.
Geo. F. Blake Mfg. Co., New York.
General Electric Co., New York.
C. W. Hunt Co., New York.
Ingersoll-Sergeant Drill Co., N. Y.
Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.
Arthur Koppel, New York.
Laidlaw-Dunn-Gordon Co., New York.
Lambert Hoist. Engine Co., Newark.
A. Leschen & Sons Rope Co., St. Louis.
Link-Belt Eng'g Co., Phila.
John H. McGowan Co., Cincinnati.
Norwalk Iron Wks., So. Norwalk, Ct.
Rand Drill Co., New York.
Ridgway Belt Conveyor Co., N. Y.
Robins Conveying Belt. Co., N. Y.
Triumph Electric Co., Cincinnati.
Vulcan Iron Wks., Toledo.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Wellman-Seaver-Morgan Co., Cleveland.
Henry R. Worthington, New York.

Coal Screens.
Allis-Chalmers Co., Chicago.
Hendrick Mfg. Co., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
W. S. Tyler Co., Cleveland.

Coil Pipe.
Whitlock Coil Pipe Co., Hartford.

Coak Oven Machinery.
Wellman-Seaver-Morgan Co., Cleveland.

Cold Saw Cutting-off Mchs.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Railway Appliances Co., Chicago.

Comptometers.
Felt & Tarrant Mfg. Co., Chicago.

Concentrators.
P. B. McCabe & Co., Los Angeles.

Concrete Mixers.
Contractors' Supply & Eqpt. Co., Chicago.
W. D. Dunning, Syracuse, N. Y.

Condensers.
Alberger Condenser Co., New York.
Allis-Chalmers Co., Chicago.
Geo. F. Blake Mfg. Co., New York.
Deane Steam Pump Co., New York.
Epping-Carpenter Co., Pittsburg.
Guild & Garrison, Brooklyn.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., N. Y.
John H. McGowan Co., Cincinnati.
Snow Steam Pump Wks., New York.
Southwark Fdy. & Mch. Co., Phila.
Struthers-Wells Co., Warren, Pa.
Union Steam Pump Co., Battle Creek.
Henry R. Worthington, New York.

Conduit Systems.
G. M. Gest, New York.

Contractors' Elevators.
Am. Hoist & Derrick Co., St. Paul.

Contractors' Supplies.
Am. Hoist & Derrick Co., St. Paul.
A. Leschen & Sons Rope Co., St. Louis.

Controllers.
Cutler-Hammer Mfg. Co., Milwaukee.
Elec. Controller & Supply Co., Cleveland.

Controllers, Pump.
Federal Valve Co., Seattle.

Conveying Machinery.
Broderick & Bascom Rope Co., St. Louis.
Browning Eng'g Co., Cleveland.
H. W. Caldwell & Sons Co., Chicago.
Frick Co., Waynesboro, Pa.
Cortlandt St. Iron Wks., Jersey City.
Hayward Co., New York.
C. W. Hunt Co., New York.
Interstate Eng'g Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Arthur Koppel, New York.
A. Leschen & Sons Rope Co., St. Louis.
Lidgerwood Mfg. Co., New York.
Link-Belt Eng'g Co., Phila.
Ridgway Belt Conveyor Co., N. Y.

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Robins Conveying Belt Co., N. Y.
Russel Wheel & Fdy. Co., Detroit.
Trenton Iron Co., Trenton, N. J.
Webster Mfg. Co., Chicago.
Wellman-Seaver-Morgan Co., Cleveland.

Cooling Towers.

Alberger Condenser Co., New York.
George Stocker, St. Louis.
Henry R. Worthington, New York.

Copper.

Orford Copper Co., New York.

Corn Oil Machinery.

Hanna Eng'g Wks., Chicago.

Corporation Counselors.

Everett Audit Co., Chicago.

Cost Systems.

Everett Audit Co., Chicago.
Gunn & Richards, New York.

Couplings.

Almond Mfg. Co., Brooklyn.

Cranes.

Am. Hoist & Derrick Co., St. Paul.
Browning Eng'g Co., Cleveland.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Interstate Eng'g Co., Cleveland.
Niles-Bement-Pond Co., New York
Riter-Conley Mfg. Co., Pittsburg.
Shaw Elec. Crane Co., Muskegon, Mich.
Frank B. Stratford, New York.
Wellman-Seaver-Morgan Co., Cleveland.
Wilcox Mfg. Co., Aurora, Ill.
R. D. Wood & Co., Phila.

Crucibles.

Jos. Dixon Crucible Co., Jersey City.
S. Obermayer Co., Cincinnati.
J. D. Smith Fdy. Supply Co., Cleveland.

Crushers, Ore, Phosphate, Rock.

Allis-Chalmers Co., Chicago.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Sturtevant Mill Co., Boston.
Wellman-Seaver-Morgan Co., Cleveland.

Cupolas.

S. Obermayer Co., Cincinnati.
J. D. Smith Fdy. Supply Co., Cleveland.
Riter-Conley Mfg. Co., Pittsburg.
Russel Wheel & Fdy. Co., Detroit.

Cutters, Millin~

Becker-Brainard Mill. Mch. Co., Hyde Park, Mass.
Standard Tool Co., Cleveland.

Derricks.

Am. Hoist & Derick Co., St. Paul.
Contractors' Plant Mfg. Co., Buffalo.
Frank B. Stratford, New York.

Derrick Fittings.

Am. Hoist & Derrick Co., St. Paul.
Contractors' Plant Mfg. Co., Buffalo.

Digesters.

Atlantic Works, East Boston, Mass.
Riter-Conley Mfg. Co., Pittsburg.
Tippett & Wood, Phillipsburg, Pa.
Robt. Wetherill & Co., Chester, Pa.

Drilling Machines.

Am. Tool Wks. Co., Cincinnati.
W. F. & J. Barnes Co., Rockford, Ill.
Chicago Pneu. Tool Co., Chicago.
Jas. Clark, Jr., & Co., Louisville.
Cleveland Pneu. Tool Co., Cleveland.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Hisey-Wolf Mch. Co., Cincinnati.
Hoefer Mfg. Co., Freeport, Ill.
Pratt & Whitney Co., Hartford.
William Sellers Co., Inc., Phila.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

Drills—Rock and Coal.

Am. Diamond Rock Drill Co., New York.
Clayton Air Compress Wks., N. Y.
Davis Calyx Drill Co., New York.
Hall Steam Pump Co., Pittsburg.
Ingersoll-Sergeant Drill Co., N. Y.
Jeffrey Mfg. Co., Columbus.
Rand Drill Co., New York.

Drop Forgings.

Chicago Drop Forge & Fdy. Co., Kensington, Ill.

Drying & Calcining Machines.

Am. Engine Co., Bound Brook, N. J.
Harrison Safety Boiler Works, Phil.
Jeffrey Mfg. Co., Columbus.
B. F. Sturtevant Co., Boston.

Dynamos.

Am. Engine Co., Bound Brook, N. J.
Bullock Elec. Mfg. Co., Cincinnati.
Crocker-Wheeler Co., Ampere, N. J.
C & C Electric Co., New York.
General Electric Co., New York.
Guarantee Electric Co., Chicago.
Jantz & Leist Elec. Co., Cincinnati.
Jeffrey Mfg. Co., Columbus.
National Electric Co., Milwaukee.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, O.
Sprague Electric Co., New York.
B. F. Sturtevant Co., Boston.
Triumph Elec. Co., Cincinnati.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Ejectors.

Hancock Inspirator Co., New York.
Hayden & Derby Mfg. Co., N. Y.
Watson & McDaniel Co., Phila.

Elbows, Pipe.

Whitlock Coil Pipe Co., Hartford.

Electric Clocks.

E. Howard Clock Co., Boston.

Electric Hoists.

Am. Hoist & Derrick Co., St. Paul.
Browning Eng'g Co., Cleveland.
C & C Electric Co., New York.
C. W. Hunt Co., New York.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Niles-Bement-Pond Co., New York.
Sprague Electric Co., New York.
Wellman-Seaver-Morgan Co., Cleveland.

Elevators.

Am. Tool & Mch. Co., Boston.
H. W. Caldwell & Sons Co., Chicago.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Morse Elevator Wks., Phila.
S. Obermayer Co., Cincinnati.
Poole Eng'g & Mch. Co., Baltimore.
Triumph Elec. Co., Cincinnati.

Elevator Rope.

A. Leschen & Sons Rope Co., St Louis.

Emery Wheels.

Carborundum Co., Niagara Falls.
Frank Machinery Co., Buffalo.
Stow Flexible Shaft Co., Phila.

Engineering Instruments.

Theo. Alteneder & Sons, Phila.
Bandis Sons Co., Brooklyn.
Buff & Buff Mfg. Co., Boston.
Eugene Dietzgen Co., Chicago.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.
Queen & Co., Phila.

Engines, Blowing.

Allis-Chalmers Co., Chicago.
American Blower Co., Detroit.
Southwark Fdy. & Mch. Co., Phila.
Sprague Elec. Co., New York.
Wm. Tod Co., Youngstown.
Wellman-Seaver-Morgan Co., Cleveland.

Engines, Marine.

Atlantic Works, East Boston, Mass.
Marine Iron Wks., Chicago.
Moran Bros., Seattle, Wash.
Vulcan Iron Wks. Co., Toledo.

Engines—Gas and Gasoline.

American Well Works, Aurora, Ill.
Foos Gas Eng. Co., Springfield, O.
Lazier Gas Engine Co., Buffalo.
Snow Steam Pump Wks., New York.
Struthers-Wells Co., Warren, Pa.
Titusville Iron Co., New York.
Westinghouse Mch. Co., Pittsburg.
Wellman-Seaver-Morgan Co., Cleveland.
Westinhouse, Church, Kerr & Co., New York.

Engines, Steam.

Allis-Chalmers Co., Chicago.
American Blower Co., Detroit.
Am. Engine Co., Bound Brook, N. J.
American Well Works, Aurora, Ill.
Atlas Engine Works, Indianapolis.
Ball Engine Co., Erie, Pa.
Geo. F. Blake Mfg. Co., New York.
Contractors Supply & Eqpt. Co., Chicago.
Frick Co., Waynesboro, Pa.
Hooven, Owens, Rentschler Co., Hamilton.
P. B. McCabe & Co., Los Angeles.
Mecklenburg Iron Wks., Charlotte, N. C.
Providence Eng'g Wks., Providence.
Reeves Engine Co., New York.
Shepherd Eng'g Co., Franklin, Pa.
Southwark Fdy. & Mch. Co., Phila.
Struthers-Wells Co., Warren, Pa.
B. F. Sturtevant Co., Boston.
Titusville Iron Co., New York.
William Tod Co., Youngstown.
Wellman-Seaver-Morgan Co., Cleveland.
Robt. Wetherill & Co., Chester, Pa.
Westinghouse Mch. Co., Pittsburg.
Westinghouse, Church, Kerr & Co., New York.

Evaporators.

Geo. F. Blake Mfg. Co., New York.
Knowles Steam Pump Wks., N. Y.

Excavators.

Am. Hoist & Derrick Co., St. Paul.
Atlantic, Gulf & Pacific Co., N. Y.
Broderick & Bascom Rope Co., St. Louis.
Bucyrus Co., So. Milwaukee, Wis.
Hayward Co., New York.
Kingsford Fdy. & Mch. Wks., Oswego, N. Y.
Jeffrey Mfg. Co., Columbus.
A. Leschen & Sons Rope Co., St. Louis.
Marion Steam Shovel Co., Marion, O.
Robins Conveying Belt Co., N. Y.
Frank B. Stratford, New York.
Vulcan Iron Wks., Toledo.

Exhaust Heads.

Am. Spiral Pipe Wks., Chicago.
Direct Separator Co., Syracuse.
Hoppes Mfg. Co., Springfield, O.
Pittsburg Gage & Supply Co., Pittsburg.
B. F. Sturtevant Co., Boston.
Watson & McDaniel Co., Phila.
Wright Mfg. Co., Detroit.

Expansion Bolts.

Isaac Church, Toledo.

Fans, Ventilating.

Allis-Chalmers Co., Chicago.
American Blower Co., Detroit.
Green Fuel Economizer Co., Matteawan, N. Y.
Power-Specialty Co., New York.
Sprague Electric Co., New York.
B. F. Sturtevant Co., Boston.

Feed Pump Controllers.

Federal Valve Co., Seattle.

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Feed-Water Heaters and Purifiers.

Allis-Chalmers Co., Chicago.
Am. Water Softener Co., Phila.
Geo. F. Blake Mfg. Co., New York.
Goubert Mfg. Co., New York.
Green Fuel Economizer Co., Matteawan, N. Y.
Harrison Safety Boiler Wks., Phila.
Knowles Steam Pump Wks., N. Y.
Hoppes Mfg. Co., Springfield, O.
John H. McGowan Co., Cincinnati.
Providence Eng'g Wks., Providence.
Ross Valve Co., Troy.
Wm. B. Scaife & Sons Co., Pittsburg.
Stewart Heater Co., Buffalo.
Warren Webster & Co., Camden, N.J.
Robt. Wetherill & Co., Chester, Pa.
Henry R. Worthington, New York.

Files and Rasps.

G. & H. Barnett Co., Phila.
Nicholson File Co., Providence.

Filters.

Am. Water Softener Co., Phila.
L. O. Koven & Bro., New York.
N. Y. Cont. Jewell Filt. Co., N. Y.
Ross Valve Co., Troy.
Wm. B. Scaife & Sons Co., Pittsburg.
Robt. Wetherill & Co., Chester, Pa.

Fire Brick.

Henry Maurer & Son, New York.
National Pyrogranit Co., New York.
S. Obermayer Co., Cincinnati.
J. D. Smith Fdy. Supply Co., Cleveland.

Fireproof Building Materials.

Clinton Fireproofing System, N. Y.
Henry Maurer & Son, New York.
Roebling Construction Co., New York.

Fireproof Frames.

Josephus Plenty Skylight Wks., Jersey City.

Flanges.

E. M. Dart Mfg. Co., Providence.

Flanges (Weldless Steel).

Am. Spiral Pipe Wks., Chicago.

Flexible Shafts.

Chicago Flexible Shaft Co., Chicago.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

Flexible Steel Tubing.

Almond Mfg. Co., Brooklyn.

Float Valves.

Foster Eng'g Co., Newark.

Floor and Sidewalk Lights.

T. H. Brooks & Co., Cleveland.
Russel Wheel & Fdy. Co., Detroit.

Fly Wheels.

Allis-Chalmers Co., Chicago.
Poole Eng'g & Mch. Co., Baltimore.
Robt. Wetherill & Co., Chester, Pa.

Forges.

B. F. Sturtevant Co., Boston.

Forgings, Iron and Steel.

Chester B. Albree, Allegheny, Pa.
Chicago Drop Forge & Fdy. Co., Kensington, Ill.
Vulcan Iron Wks. Co., Toledo.
Wyman & Gordon, Worcester.

Foundry Equipment.

Am. Air Compressor Wks., New York.
Geo. F. Blake Mfg. Co., New York.
Buffalo Foundry Co., Buffalo.
Diamond Drill & Mch. Co., Birdsboro, Pa.
Globe Mch. & Stamping Co., Cleveland.
C. W. Hunt Co., New York.
Ingersoll-Sergeant Drill Co., N. Y.
Arthur Koppel, New York.
S. Obermayer Co., Cincinnati.
J. W. Paxson Co., Phila.
Pedrick & Ayer Co., Plainfield, N. J.
J. D. Smith Fdy. Supply Co., Cleveland.
Wellman-Seaver-Morgan Co., Cleveland.
Wilcox Mfg. Co., Aurora, Ill.

Friction Clutches.

Am. Tool & Mch. Co., Boston.
H. W. Caldwell & Sons Co., Chicago.
Elec. Controller & Supply Co., Cleveland.
Link-Belt Eng'g Co., Phila.
Poole Eng'g & Mch. Co., Baltimore.
Sinclair-Scott Co., Baltimore.

Fuel Economizers.

Green Fuel Economizer Co., Matteawan, N. Y.
Kenworthy Eng'g & Const. Co., Waterbury.
Providence Eng'g Wks., Providence.
B. F. Sturtevant Co., Boston.

Furnace Builders.

Am. Gas Furnace Co., New York.
Continental Iron Wks., Brooklyn.
Chicago Flexible Shaft Co., Chicago.
Julian Kennedy, Pittsburg.
Kenworthy Eng'g & Const. Co., Waterbury.
G. W. McClure, Son & Co., Pittsburg.
Morgan Const. Co., Worcester.
Riter-Conley Mfg. Co., Pittsburg.
Waterbury Farrel Fdy. & Mch. Co., Waterbury.
Wellman-Seaver-Morgan Co., Cleveland.

Gages — Pressure, Steam, Water.

Am. Steam Gauge & Valve Co., Boston
Ashcroft Mfg. Co., New York.
Ashton Valve Co., Boston.
Bristol Co., Waterbury, Conn.
Crosby Steam Gage & Valve Co., Boston.
Hohmann & Maurer Mfg. Co., Rochester.
Kenworthy Eng'g & Const. Co., Waterbury.
Pittsburg Gage & Supply Co., Pittsburg.
John Simmons Co., New York.
Star Brass Mfg. Co., Boston.
Walworth Mfg. Co., Boston.

Galvanizing.

L. O. Koven & Bro., New York.
John Simmons Co., New York.

Galvanizing Mchy. & Furnaces (Wire).

Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

Gas Holders and Regulators.

Continental Iron Wks., Brooklyn.
Riter-Conley Mfg. Co., Pittsburg.

Gaskets.

Boston Belting Co., Boston.

Gaskets, Corrugated Copper.

Am. Spiral Pipe Wks., Chicago.

Gear Cutting Machines.

Becker-Brainard Mill. Mch. Co., Hyde Park, Mass.

Gearing.

Allis-Chalmers Co., Chicago.
Hugo Bilgram, Phila.
Geo. F. Blake Mfg. Co., New York.
Boston Gear Works, Boston.
H. W. Caldwell & Son Co., Chicago.
D. O. James, Chicago.
Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.
Morse Elevator Works, Phila.
New Process Rawhide Co., Syracuse.
R. D. Nuttall Co., Pittsburg.
Poole Eng'g & Mch. Co., Baltimore.
Wm. Sellers Co., Inc., Phila.
Stow Flexible Shaft Co., Phila.
Robt. Wetherill & Co., Chester, Pa.

Graphite.

Jos. Dixon Crucible Co., Jersey City.
S. Obermayer Co., Cincinnati.
J. D. Smith Fdy. Supply Co., Cleveland.

Grease Separators.

Loew Supply & Mfg. Co., Cleveland.

Grinders, Electric.

Jas. Clarke, Jr., & Co., Louisville.
Hisey-Wolf Mch. Co., Cincinnati.
Northern Elec. Mfg. Co., Madison.

Grinding & Polishing Mchy.

American Tool Wks. Co., Cincinnati.
Hisey-Wolf Mch. Co., Cincinnati.
Landis Tool Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
William Sellers Co., Inc., Phila.
Stow Flexible Shaft Co., Phila.

Hammers, Electric.

Northern Elec. Mfg. Co., Cincinnati.

Hand Drill—Electric.

Hisey-Wolf Mch. Co., Cincinnati.

Heading & Upsetting Mchy.

National Mch. Co., Tiffin, Ohio.

Heating and Ventilating Apparatus.

American Blower Co., Detroit.
Hayden & Derby Mfg. Co., N. Y.
Jos. Plenty Skylgt. Wks., Jersey City.
Railway Appliances Co., Chicago.
John Simmons Co., New York.
Sprague Elec. Co., New York.
H. B. Smith Co., New York.
Stewart Heater Co., Buffalo.
B. F. Sturtevant Co., Boston.
Walworth Mfg. Co., Boston.
Warren Webster & Co., Camden, N. J.

Hoisting and Haulage Rope.

A. Leschen & Sons Rope Co., St. Louis.

Hoisting Engines and Mchy.

Allis-Chalmers Co., Chicago.
Am. Hoist & Derrick Co., St. Paul.
Brown Hoist. Mch. Co., New York.
Browning Eng'g Co., Cleveland.
Contractors' Plant Mfg. Co., Buffalo.
Contractors' Supply & Eqpt. Co., Chicago.
Gen. Pneu. Tool Co., Montour Falls, N. Y.
Hayward Co., New York.
C. W. Hunt Co., New York.
Industrial Wks., Bay City, Mich.
Interstate Eng'g Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Lambert Hoist. Eng. Co., Newark.
A. Leschen & Sons Rope Co., St. Louis.
Lidgerwood Mfg. Co., New York.
Link-Belt Eng'g Co., Phila.
P. B. McCabe & Co., Los Angeles.
Niles Tool Works Co., Hamilton.
Providence Eng'g Works, Providence.
William Sellers Co., Inc., Phila.
Sprague Elec. Co., New York.
Frank B. Stratford, New York.
Stuebner Iron Wks., Long Isld. City.
Trenton Iron Co., Trenton, N. J.
Vulcan Iron Wks. Co., Toledo.
Wellman-Seaver-Morgan Co., Cleveland.

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Hose.
Boston Belting Co., Boston.
Eureka Fire Hose Co., New York.

Hydraulic Machinery.
Union Steam Pump Co., Battle Creek, Mich.
Warren Steam Pump Co., Warren, Mass.

Hydraulic Rams.
Pelton Water Wheel Co., 'Frisco.
Power Specialty Co., New York.

Ice-Mak'g & Refriger. Mchy.
Geo. F. Blake Mfg. Co., New York.
Deane Steam Pump Co., New York.
Frick Co., Waynesboro, Pa.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., N. Y.
H. B. Roelker, New York.
Snow Steam Pump Wks., New York.
Westinghouse, Church, Kerr & Co., New York.
Westinghouse Mch. Co., Pittsburg.
Henry R. Worthington, New York.

Injectors.
Hayden & Derby Mfg. Co., N. Y.
John Simmons Co., New York.

Insulating Materials.
Sterling Varnish Co., Pittsburg.

Internal Gearing.
R. D. Nuttall Co., Pittsburg.

Iron and Bronze, Ornamental.
W. S. Tyler Co., Cleveland.

Jacks, Hydraulic.
Watson-Stillman Co., New York.

Kiers.
Atlantic Works, East Boston, Mass.

Lamps, Electric.
General Electric Co., New York.
C. J. Toerring Co., Phila., Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Lamps, Incandescent.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Sawyer-Man Elec. Co., Pittsburg.

Lathes.
American Tool & Mch. Co., Boston.
American Tool Wks. Co., Cincinnati.
W. F. & J. Barnes Co., Rockford, Ill.
Bullard Mch. Tool Co., Bridgeport, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
William Sellers Co., Inc., Phila.
Waterbury Farrel Fdy. & Mch. Co., Waterbury.

Lifting Magnets.
Elec. Controller & Supply Co., Cleveland.

Light Railways.
C. W. Hunt Co., New York.
Arthur Koppel, New York.
Link-Belt Eng'g Co., Phila.
Russel Wheel & Fdy. Co., Detroit.
Stuebner Iron Wks., Long Isld. City.

Lockers.—Metal
Edw. Darby & Sons Co., Phila.
Merritt & Co., Phila.

Locomotive Cranes.
Amer. Hoist & Derrick Co., St. Paul.
Browning Eng'g Co., Cleveland.
Industrial Wks., Bay City, Mich.
Interstate Eng'g Co., Cleveland.
Frank B. Stratford, New York.
Wellman-Seaver-Morgan Co., Cleveland.

Locomotives, Electric.
American Locomotive Co., New York.
Baldwin Locomotive Wks., Phila.
Contractors' Supply Co., Chicago.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
C. W. Hunt Co., New York.
Jeffrey Mfg. Co., Columbus.
Arthur Koppel, New York.
H. K. Porter Co., Pittsburg.
Rogers Locomotive Works, Paterson.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Locomotive Switch Ropes.
A. Leschen & Sons Rope Co., St. Louis.

Lubricants.
Jos. Dixon Crucible Co., Jersey City.

Lubricating & Oiling Devices.
E. M. Dart Mfg. Co., Providence.
Pittsburg Gage & Supply Co., Pittsburg.

Machinery Exhibits.
Bourse, Philadelphia.

Machinists' Small Tools.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford.
William Sellers Co., Inc., Phila.
Standard Tool Co., Cleveland.

Marine Engines.
Marine Iron Works, Chicago.

Mechanical Draft.
Green Fuel Economizer Co., Matteawan, N. Y.

Meters, Electric.
General Electric Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Weston Elec. Inst. Co., Waverly Park, N. J.

Milling Machines.
Adams Co., Dubuque, Iowa.
American Tool & Mch. Co., Boston.
American Tool Wks. Co., Cincinnati.
Becker-Brainard Mill. Mch. Co., Hyde Park, Mass.
Bullard Mch. Tool Co., Bridgeport, Conn.
Hess-Bright Co., Phila.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Mill Supplies.
Pittsburg Gage & Supply Co., Pittsburg.

Mine Cars.
Allis-Chalmers Co., Chicago.
C. W. Hunt Co., New York.
Jeffrey Mfg. Co., Columbus.
Arthur Koppel, New York.
Russel Wheel & Fdy. Co., Detroit.
Wellman-Seaver-Morgan Co., Cleveland.

Mining Machinery.
Allis-Chalmers Co., Chicago.
Am. Diamond Rock Drill Co., N. Y.
Geo. F. Blake Mfg. Co., New York.
Broderick & Bascom Rope Co., St. Louis.
Contractors' Supply & Eqpt. Co., Chicago.
Davis Calyx Drill Co., New York.
Deane Steam Pump Co., New York.
Diamond Drill & Mch. Co., Birdsboro, Pa.
General Electric Co., New York.
Ingersoll-Sergeant Drill Co., N. Y.
Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.
Arthur Koppel, New York.
Laidlaw-Dunn-Gordon Co., New York.
Lambert Hoist. Eng. Co., Newark.
A. Leschen & Sons Rope Co., St. Louis.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
John H. McGowan Co., Cincinnati.
Mecklenburg Iron Wks., Charlotte, N. C.
Norwalk Iron Wks., So. Norwalk, Ct.
Power Specialty Co., New York.
Providence Eng'g Wks., Providence.
Rand Drill Co., New York.
Ridgway Belt Conveyor Co., N. Y.
Robins Conveying Belt Co., N. Y.
Snow Steam Pump Wks., New York.
Trenton Iron Wks. Co., Trenton, N. J.
Union Steam Pump Co., Battle Creek, Mich.
Vulcan Iron Wks. Co., Toledo.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Wellman-Seaver-Morgan Co., Cleveland.
Henry R. Worthington, New York.

Motors, Electric.
Am. Engine Co., Bound Brook, N. J.
Bullock Elec. Mfg. Co., Cincinnati.
C & C Electric Co., New York.
Elec. Controller & Supply Co., Cleveland.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Guarantee Elec. Co., Chicago.
Jantz & Leist Elec. Co., Cincinnati.
Jeffrey Mfg. Co., Columbus.
National Elec. Co., Milwaukee.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, O.
Sprague Electric Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
B. F. Sturtevant Co., Boston.
Triumph Electric Co., Cincinnati.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Moulding Machines.
Geo. F. Blake Mfg. Co., New York.
Frank Mchy. Co., Buffalo.
S. Obermayer Co., Cincinnati.
J. W. Paxson Co., Phila.
Power Specialty Co., New York.
J. D. Smith Fdy. Supply Co., Cleveland.
Tabor Mfg. Co., Phila.

Name Plates and Labels.
Am. Ry. Supply Co., New York.
Schwerdtle Stamp Co., Bridgeport

Naphtha Gas Machines.
Am. Gas Furnace Co., New York.

Nickel.
Benedict & Burnham Mfg. Co., Waterbury.
Orford Copper Co., New York.

Nozzles.
Abner Doble Co., San Francisco.

Nozzle and Sleeve Press.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

Nut Tappers.
National Mchy. Co., Tiffin, Ohio.

Oil Burners.
C. A. Hammel, Los Angeles.

Oil Filters.
Loew Supply & Mfg. Co., Cleveland.
Pittsburg Gage & Supply Co., Pittsburg.

Oil Systems.
Pittsburg Gage & Supply Co., Pittsburg.

Overhead Trolley Systems.
Wilcox Mfg. Co., Aurora, Ill.

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Package Carriers.
Lamson Consolidated S. S. Co., Boston.

Packing.
Boston Belting Co., Boston.
Broderick & Bascom Rope Co., St. Louis.
Jenkins Brothers, New York.
A. Leschen & Sons Rope Co., St. Louis.
Mabbs Hyd. Pack. Co., Chicago.

Paints and Varnishes.
Jos. Dixon Crucible Co., Jersey City.
Lowe Bros. Co., Dayton, Ohio.
Paraffine Paint Co., San Francisco.
Sterling Varnish Co., Pittsburg.

Pattern-Makers' Machinery.
Fay & Egan Co., Cincinnati.
Frank Machinery Co., Buffalo.
Pratt & Whitney Co., Hartford.
J. D. Smith Fdy. Supply Co., Cleveland.

Pattern Makers.
Diamond Drill & Mch. Co., Birdsboro, Pa.

Pavement.
Warren Bros. Co., New York.

Perforated Metal.
Allis-Chalmers Co., Chicago.
H. W. Caldwell & Sons Co., Chicago.
Hendrick Mfg. Co., Carbondale, Pa.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

Phosphor Bronze.
Phosphor Bronze Smelt. Co., Phila.
Poole Eng'g & Mch. Co., Baltimore.

Pick-Up Carriers.
Lamson Consolidated S. S. Co., Boston.

Pile Drivers.
Am. Hoist & Derrick Co., St. Paul.
Bucyrus Co., So. Milwaukee.
Ingersoll-Sergeant Drill Co., N. Y.
Interstate Eng'g Co., Cleveland.
Vulcan Iron Works Co., Toledo.

Pipe.
Am. Spiral Pipe Wks., Chicago.
L. O. Koven & Bro., New York.
Pelton Water Wheel Co., 'Frisco.
Pittsburg Gage & Supply Co., Pittsburg.
John Simmons, New York.
U. S. Cast Iron Pipe & Fdy. Co., Phila.
Walworth Mfg. Co., Boston.
Whitlock Coil Pipe Co., Hartford.

Pipe Bending.
Whitlock Coil Pipe Co., Hartford.

Pipe-Cutting and Threading Machines.
Cox & Sons Co., Bridgeton, N. J.
Curtis & Curtis Co., Bridgeport, Ct.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
John Simmons Co., New York.
Walworth Mfg. Co., Boston.

Pipe Fittings, Cast-Iron.
American Spiral Pipe Wks., Chicago.
Pelton Water Wheel Co., San Francisco.
Pittsburg Gage & Supply Co., Pittsburg.
John Simmons Co., New York.
Walworth Mfg. Co., Boston.

Pipe Vises.
John Simmons Co., New York.

Piston Rods.
B. M. Jones & Co., Boston.

Planers.
Am. Tool Wks. Co., Cincinnati.
Frank Machinery Co., Buffalo.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Planing Mill Machinery.
Fay & Egan Co., Cincinnati.
Frank Machinery Co., Buffalo.

Pneumatic Tools.
Am. Air Compress. Wks., N. Y.
Chicago Pneu. Tool Co., Chicago.
Clayton Air Compress. Wks., N. Y.
Cleveland Pneu. Tool Co., Cleveland.
Curtis & Co. Mfg. Co., St. Louis.
Ingersoll-Sergeant Drill Co., N. Y.
Railway Appliances Co., Chicago.
Rand Drill Co., New York.

Pneumatic Tubes.
Lamson Consolidated S. S. Co., Boston.

Pop Safety Valves.
Am. Steam Gauge & Valve Co., Boston.
Ashton Valve Co., Boston.
Consolidated Safety Valve Co., N. Y.
Crosby Steam Gauge & Valve Co., Boston.
Star Brass Mfg. Co., Boston.

Portable Drilling Machines.
Hisey-Wolf Mch. Co., Cincinnati.

Portable Time Stamps.
Perry Time Stamping Co., Chicago.

Power Machinery, Steam or Water.
Wellman-Seaver-Morgan Co., Cleveland.

Power-Transmission Mchy.
Allis-Chalmers Co., Chicago.
Broderick & Bascom Rope Co., St. Louis.
H. W. Caldwell & Sons Co., Chicago.
General Electric Co., New York.
Hayward Co., New York.
Jeffrey Mfg. Co., Columbus.
A. Leschen & Sons Rope Co., St. Louis.
Link-Belt Eng'g Co., Phila.
Mecklenburg Iron Wks., Charlotte, N. C.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Belt Conveyor Co., N. Y.
Robins Conveying Belt. Co., N. Y.
Sprague Electric Co., New York.
Triumph Electric Co., Cincinnati.
Webster Mfg. Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
R. D. Wood & Co., Phila.

Presses and Dies.
Curtis & Curtis Co., Bridgeport.
Niagara Mch. & Tool Wks., Buffalo.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Waterbury Farrel Fdy. & Mch. Co., Waterbury.
Watson-Stillman Co., New York.
R. D. Wood & Co., Phila.

Production Engineers.
Everett Audit Co., Chicago.
Gunn, Richards & Co., New York.

Prospecting Drills.
Am. Diamond Rock Drill Co., N. Y.
Am. Well Wks., Aurora, Ill.
Davis Calyx Drill Co., New York.

Pulleys, Shafting & Hangers.
Allis-Chalmers Co., Chicago.
Am. Tool & Mch. Co., Boston.
Buhl Malleable Co., Detroit.
H. W. Caldwell & Sons Co., Chicago.
Fay & Egan, Cincinnati.
Frank Machinery Co., Buffalo.
Jeffrey Mfg. Co., Columbus.
A. Leschen & Sons Rope Co., St. Louis.
Niles Tool Works Co., New York.
Poole Eng'g & Mch. Co., Baltimore.
Robins Conveying Belt Co., N. Y.
Sinclair-Scott Co., Baltimore.

Pump Controllers.
Federal Valve Co., Seattle.

Pumping Engines.
Geo. F. Blake Mfg. Co., New York.
Deane Steam Pump Co., New York.
Holly Mfg. Co., New York.
Knowles Steam Pump Wks., New York.
Laidlaw-Dunn-Gordon Co., New York.
Lawrence Mch. Co., Lawrence, Mass.
Lawrence Pump & Eng. Co., Lawrence, Mass.
Snow Steam Pump Wks., New York.
Warren Steam Pump Co., Warren, Mass.
Henry R. Worthington, New York.

Pumps and Pumping Mchy.
Alberger Condenser Co., New York.
Allis-Chalmers Co., Chicago.
American Well Wks., Aurora, Ill.
Ashcroft Mfg. Co., New York.
Geo. F. Blake Mfg. Co., New York.
Bucyrus Co., So. Milwaukee.
Cameron Steam Pump Wks., N. Y.
Clayton Air Compress. Wks., N. Y.
Deane Steam Pump Co., New York.
Epping-Carpenter Co., Pittsburg.
Flint & Walling Mfg. Co., Kendallville, Ind.
Guild & Garrison, Brooklyn.
Hall Steam Pump Co., Pittsburg.
Ingersoll-Sergeant Drill Co., N. Y.
Kenworthy Eng'g & Const. Co., Waterbury.
Kingsford Fdy. & Mch. Wks., Oswego, N. Y.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Lawrence Mch. Co., Lawrence, Mass.
Lawrence Pump & Eng. Co., Lawrence, Mass.
Luitwieler Pump. Eng. Co., Los Angeles.
John H. McGowan Co., Cincinnati.
Mecklenburg Iron Wks., Charlotte, N. C.
Morris Mch. Wks., Baldwinsville, N. Y.
Pneumatic Eng'g Co., New York.
Providence Eng'g Wks., Providence.
Snow Steam Pump Wks., New York.
Southwark Fdy. & Mch. Co., Phila.
William Tod Co., Youngstown.
Union Steam Pump Co., Battle Creek, Mich.
Warren Steam Pump Co., Warren, Mass.
Watson-Stillman Co., New York.
Robt. Wetherill & Co., Chester, Pa.
R. D. Wood & Co., Phila.
Henry R. Worthington, New York.

Pump Valves.
Boston Belting Co., Boston.
Power Specialty Co., New York.

Punching & Shearing Mchy.
Bethlehem Fdy. & Mch. Co., So. Bethlehem, Pa.
Morgan Const. Co., Worcester.
National Machinery Co., Tiffin, O.
Niagara Mch. & Tool Wks., Buffalo.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Waterbury Farrel Fdy. & Mch. Co., Waterbury.
R. D. Wood & Co., Phila.

Radiators.
John Simmons Co., New York.
H. B. Smith Co., New York.

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Racks—Machine Cut.
R. D. Nuttall Co., Pittsburg.

Rail Braces.
Continuous Rail Joint Co., Newark.

Railroad Pumping Engine.
Lu'lwieler Pump. Eng. Co., Los Angeles.

Railway Forgings.
B. M. Jones & Co., Boston.
Railway Appliances Co., Chicago.

Railway Shop Machinery.
Chester B. Albree, Allegheny, Pa.
Am. Tool Wks. Co., Cincinnati.
W. F. & J. Barnes Co., Rockford, Ill.
Clayton Air Compress. Wks., N. Y.
Fay & Egan Co., Cincinnati.
Frank Machinery Co., Buffalo.
Ingersoll-Sergeant Drill Co., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Niles-Bement-Gordon Co., New York.
Norwalk Iron Wks., So. Norwalk, Ct.
Pratt & Whitney Co., Hartford.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.
H. B. Underwood & Co., Phila.
Watson-Stillman Co., New York.

Rawhide Packing.
Mabbs Hydraulic Pack. Co., Chicago.

Reamers.
Standard Tool Co., Cleveland.

Record. Devices—Automatic.
Perry Time Stamp Co., Chicago.

Resistance Banks and Units.
Elec. Controller & Supply Co., Cleveland.

Rheostats.
Cutler-Hammer Mfg. Co., Milwaukee.
Simplex Elec. Heat. Co., Cambridge, Mass.

Riveting Machines.
Chester B. Albree, Allegheny, Pa.
Bethlehem Fdy. & Mch. Co., So. Bethlehem, Pa.
Cleveland Pneu. Tool Co., Cleveland.
Hanna Eng'g Wks., Chicago.
Ingersoll-Sergeant Drill Co., N. Y.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Pedrick & Ayer Co., Plainfield, N. J.
Rand Drill Co., New York.
William Sellers Co., Inc., Phila.
R. D. Wood & Co., Phila.

Rivet-Making Machinery.
National Machinery Co., Tiffin, O.

Road-Makin- Machinery.
Vulcan Iron Works, Toledo.

Rock Breakers.
Allis-Chalmers Co., Chicago.
Robins Conveying Belt Co., N. Y.
Sturtevant Mill Co., Boston.

Rock Drillers, Electric.
Northern Elec. Mfg. Co., Madison, Wis.

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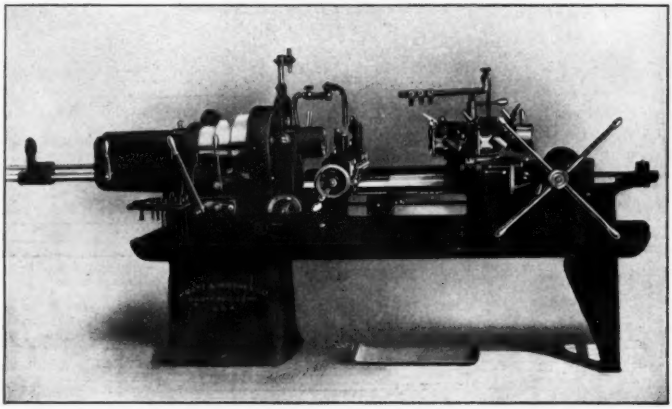

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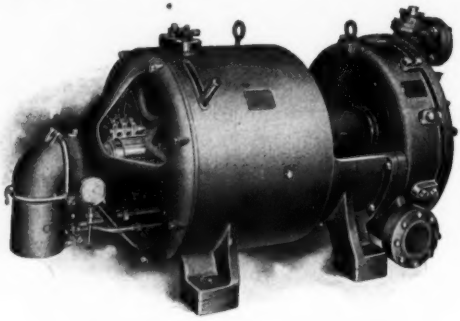

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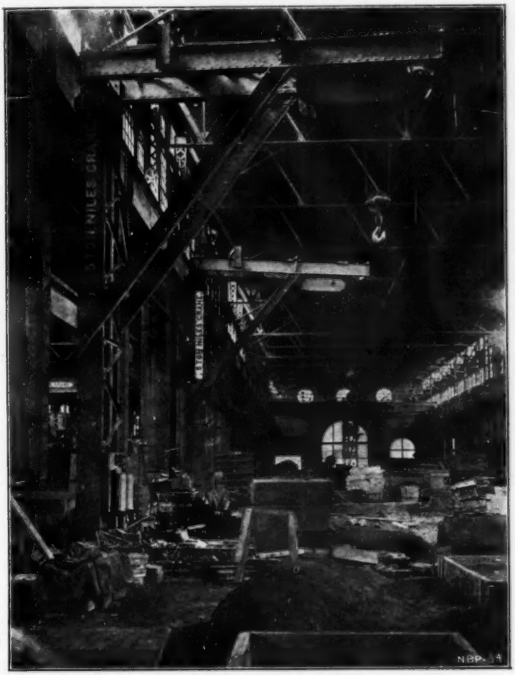

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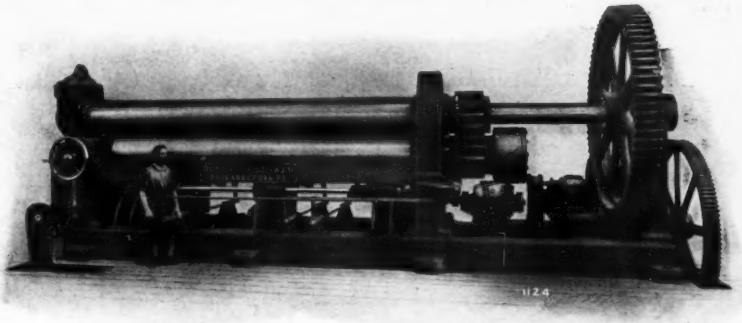

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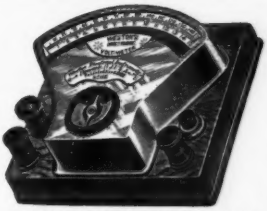

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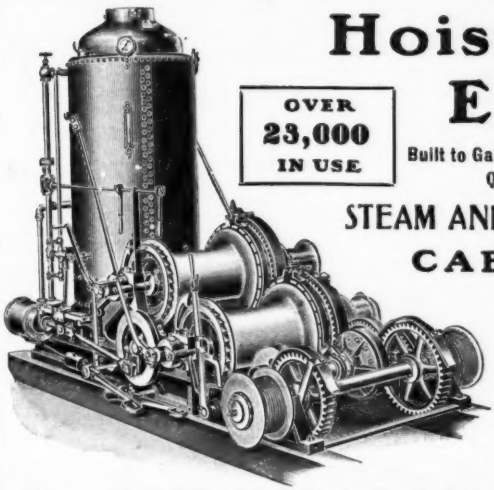

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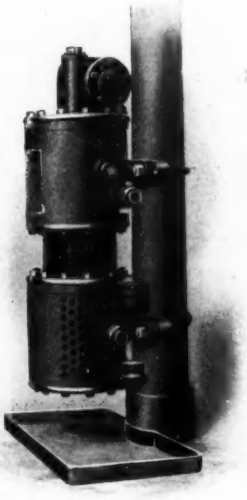

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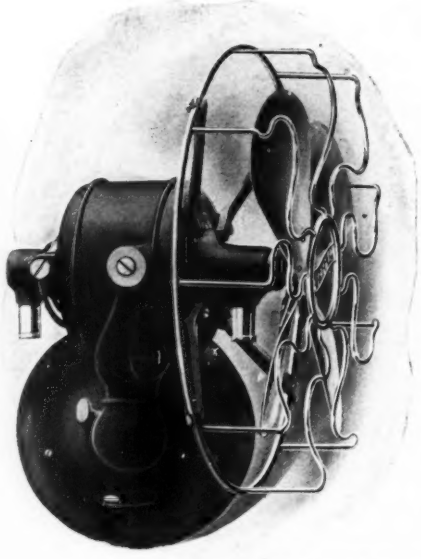

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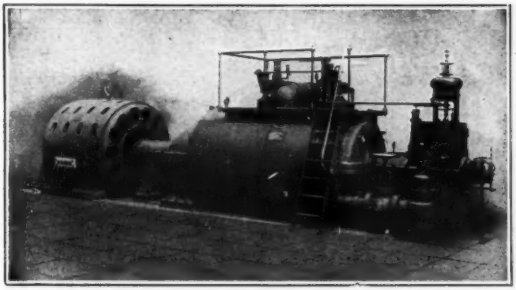

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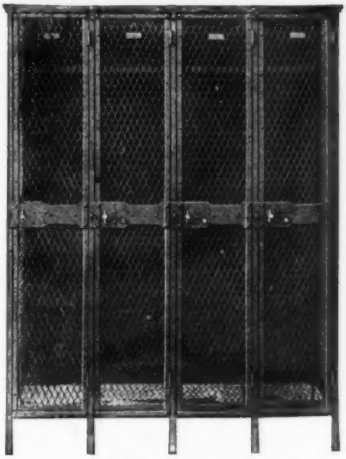

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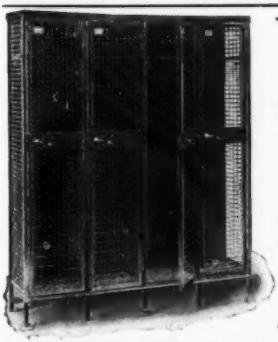

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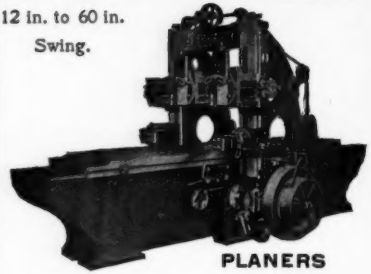

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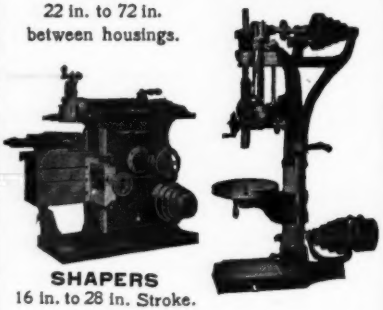

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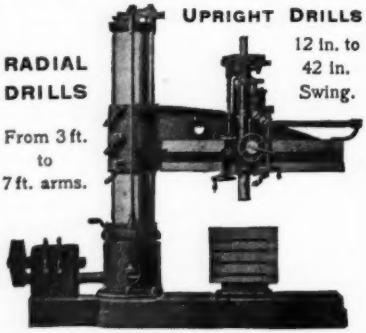

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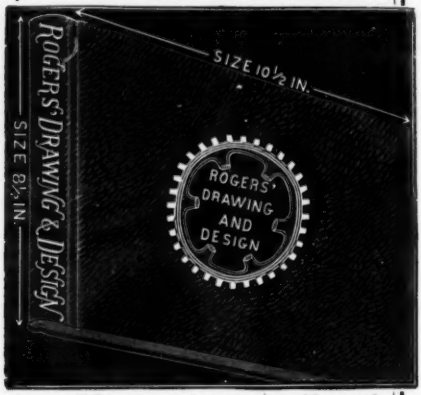

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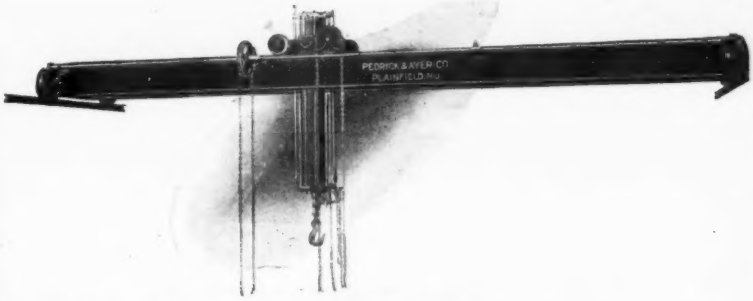

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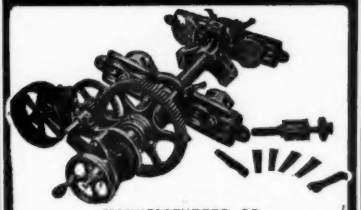

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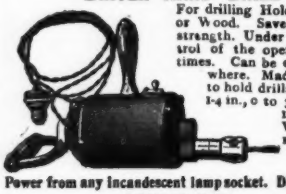

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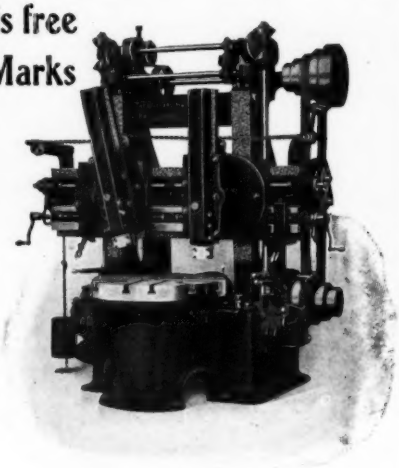

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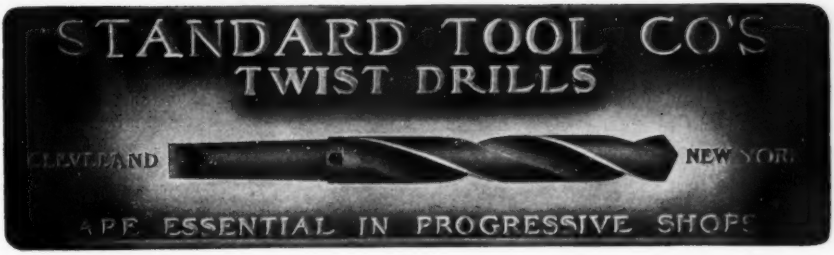

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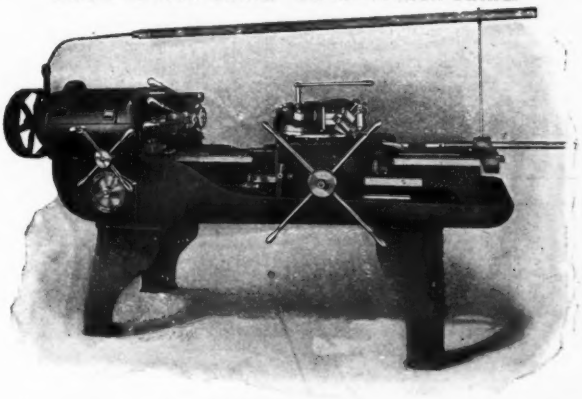

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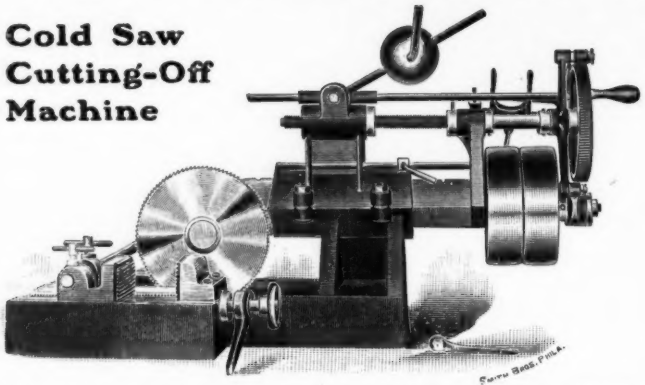

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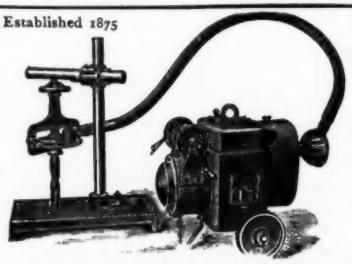

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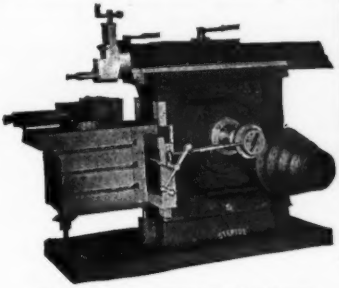

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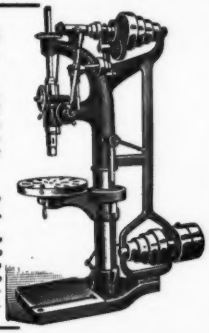

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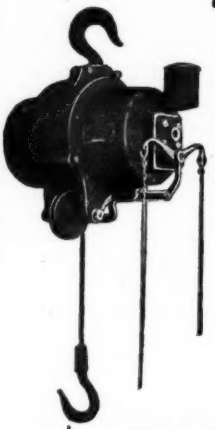

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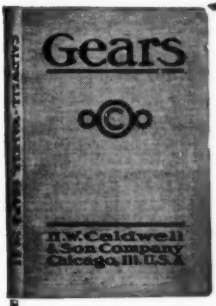

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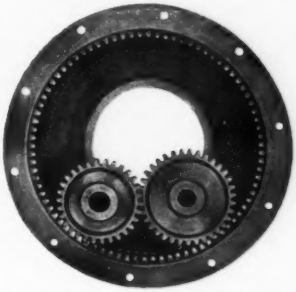

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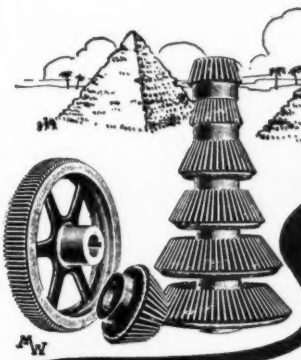

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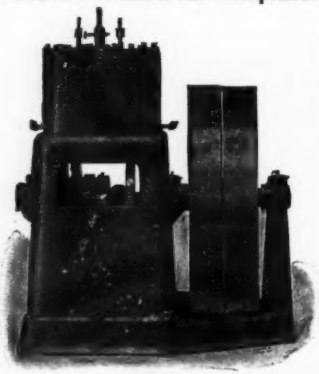

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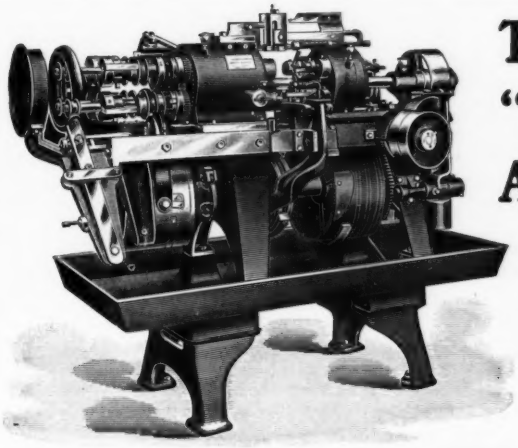

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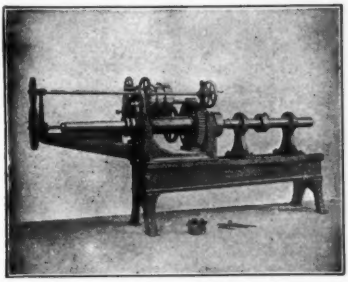

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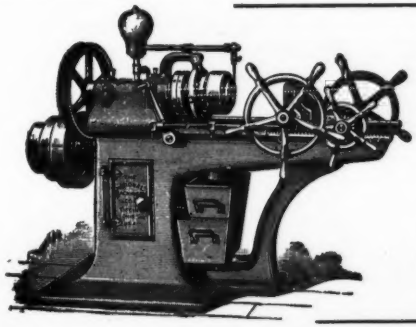

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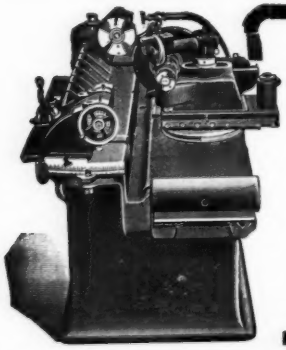

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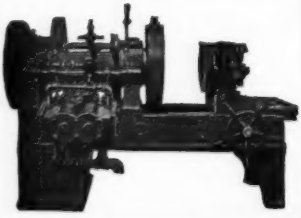

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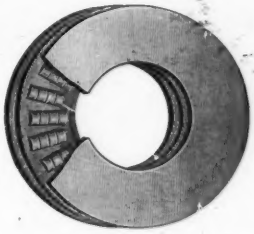

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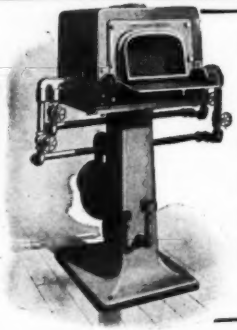

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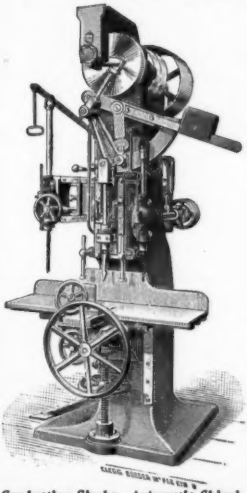

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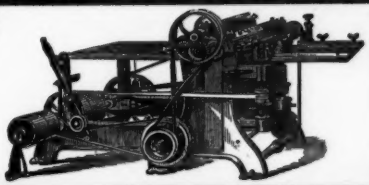

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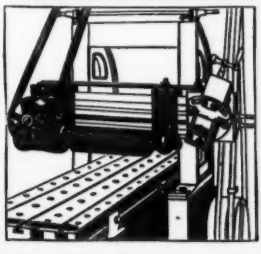

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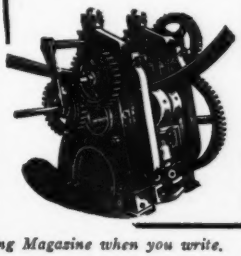

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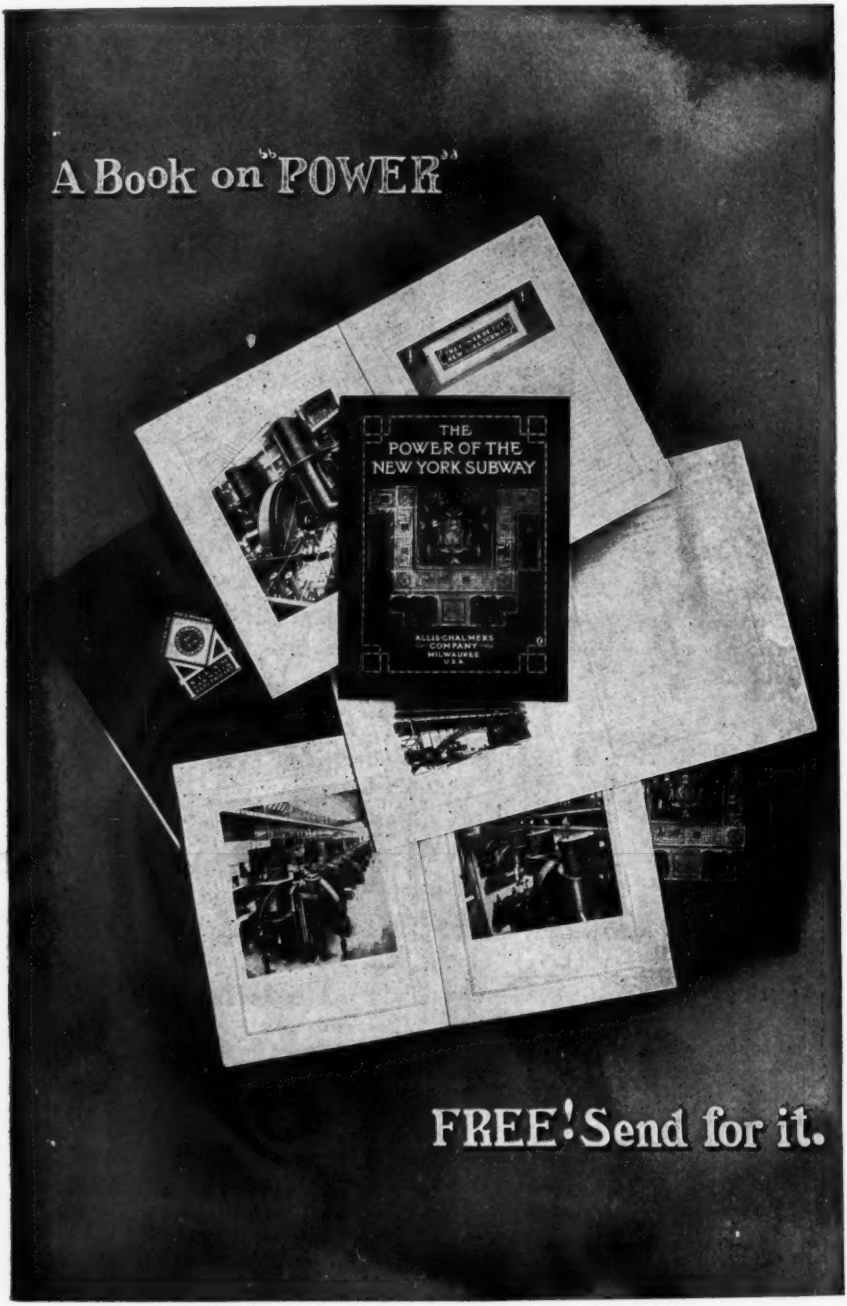

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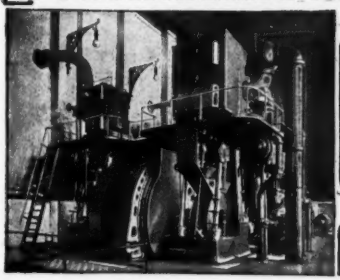

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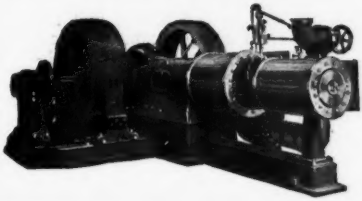

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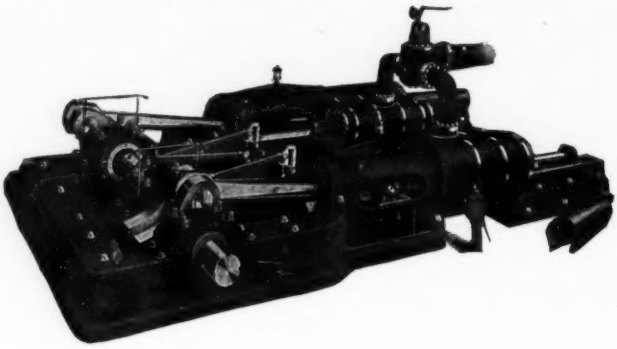

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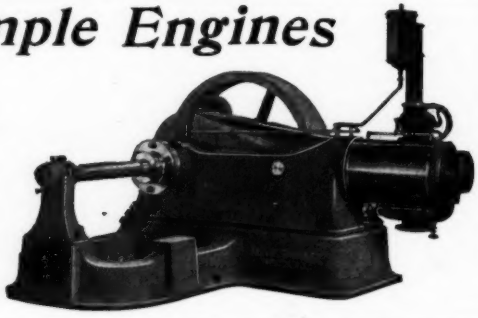

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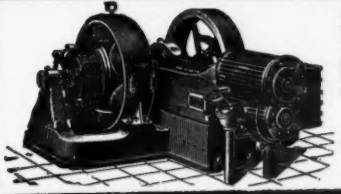

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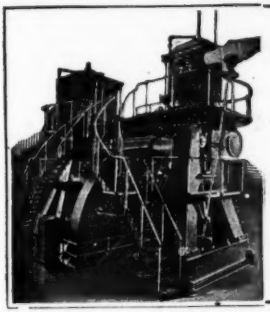

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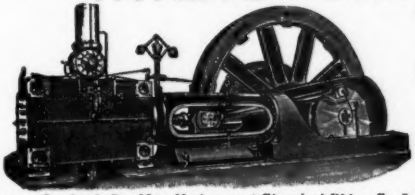

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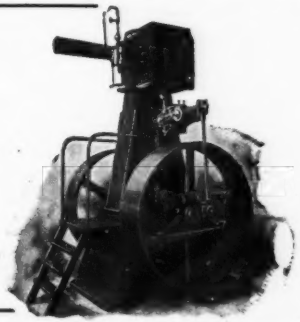

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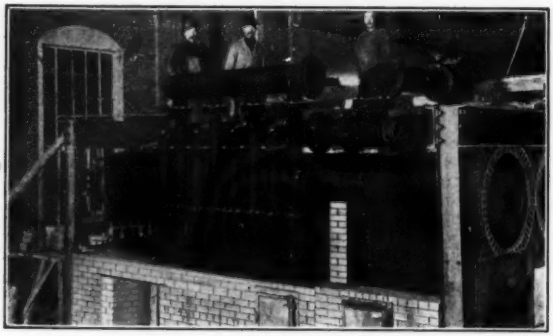

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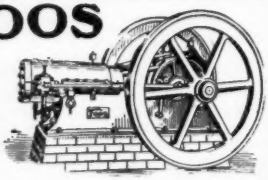

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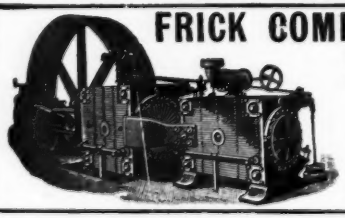

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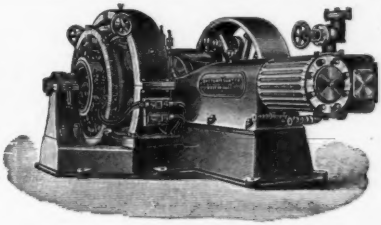

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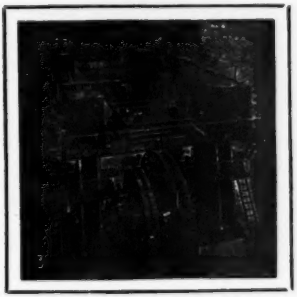

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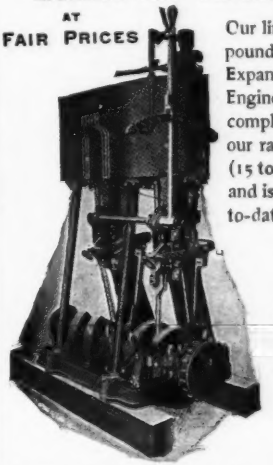

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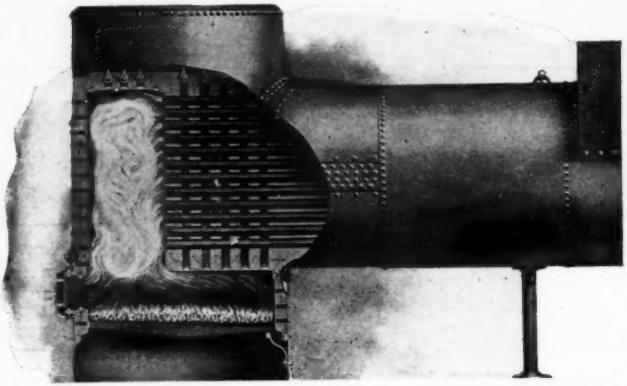

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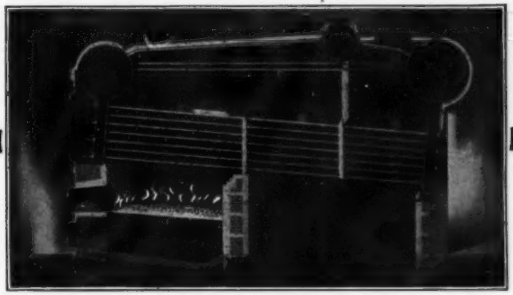

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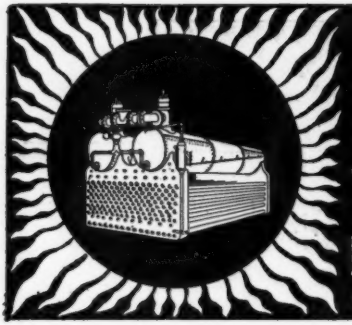

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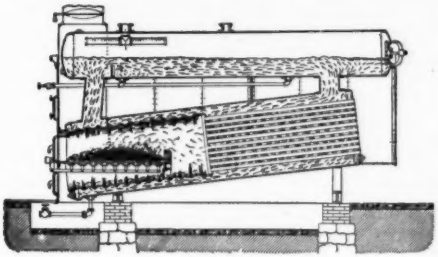

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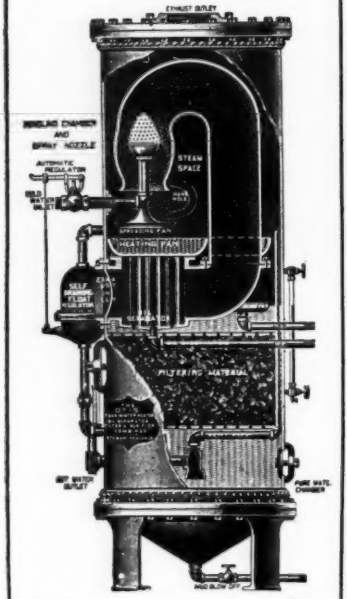

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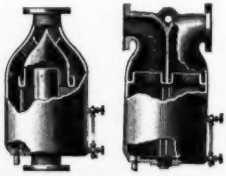

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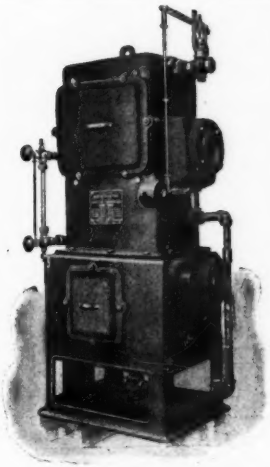

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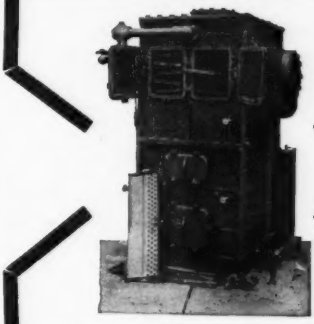

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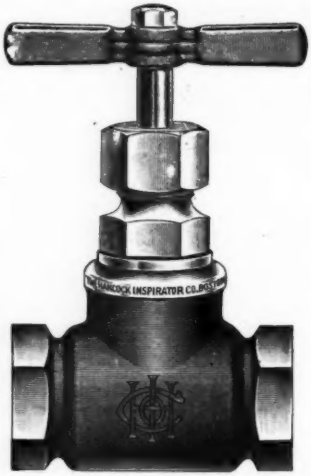

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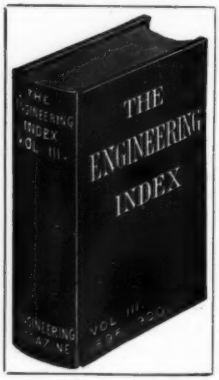

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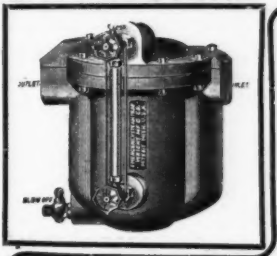

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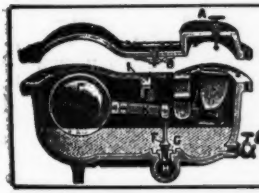

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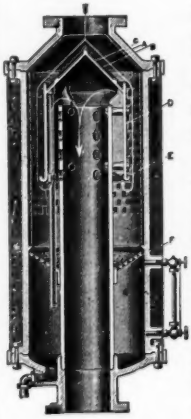

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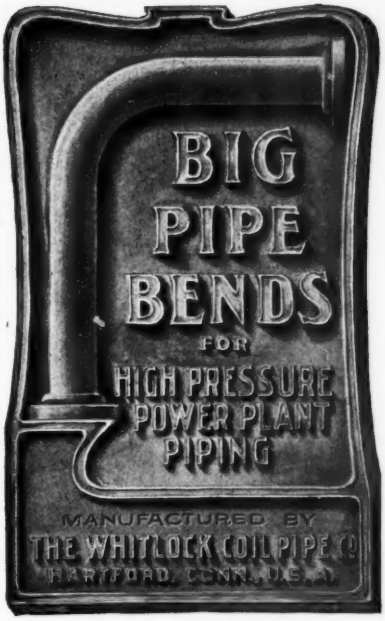

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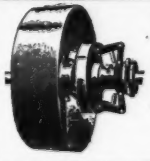

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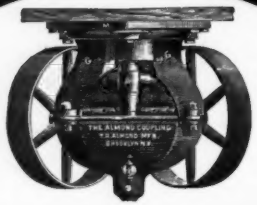

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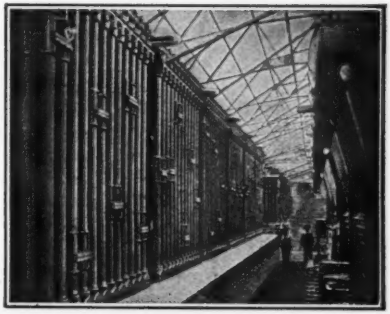

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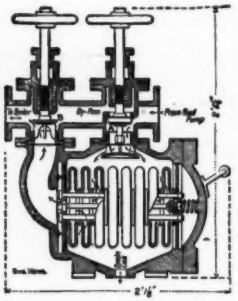

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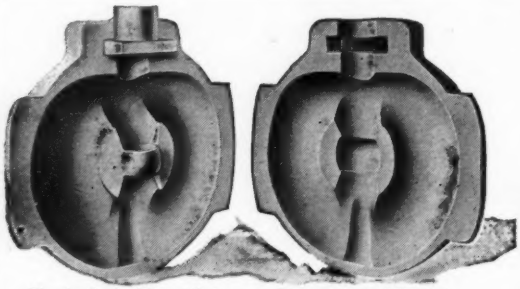

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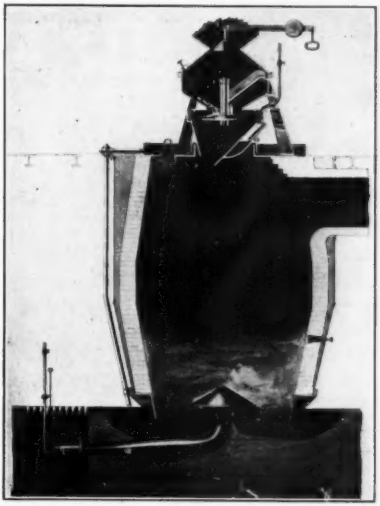

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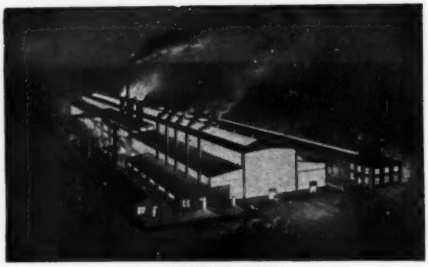

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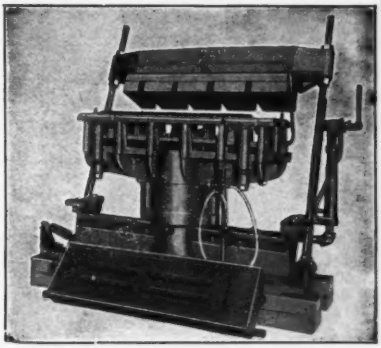

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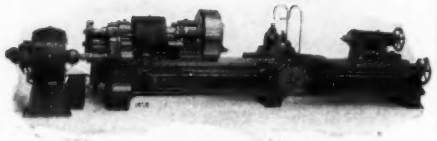

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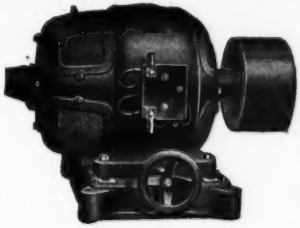

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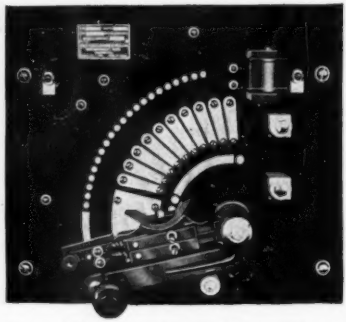

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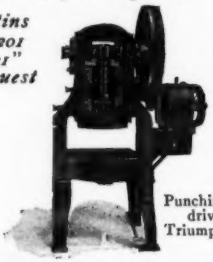

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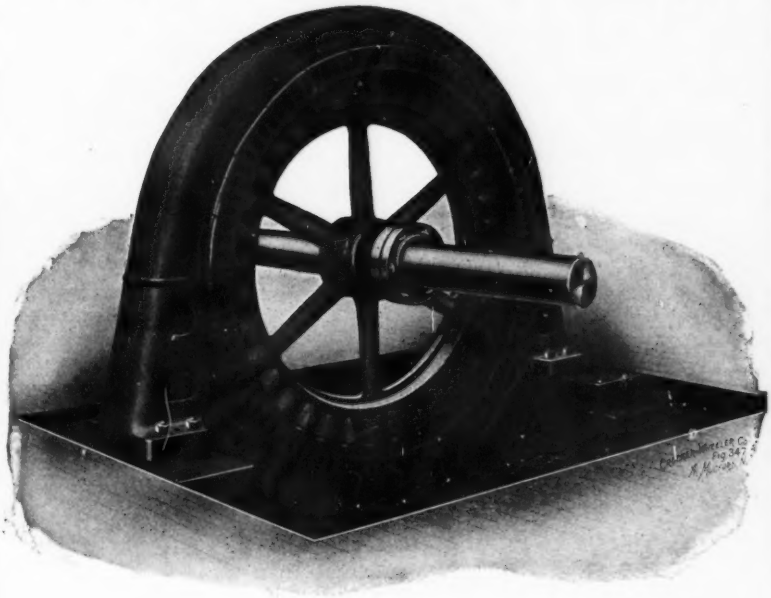

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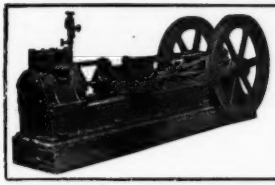

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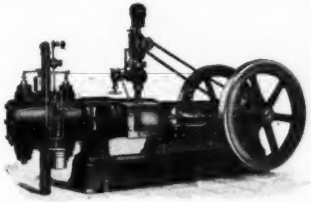

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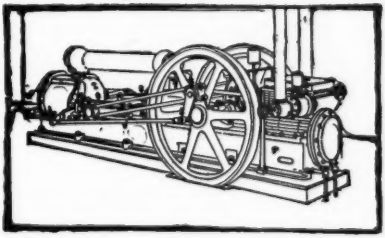

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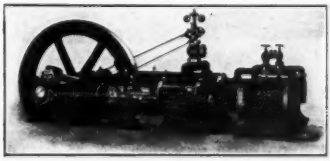

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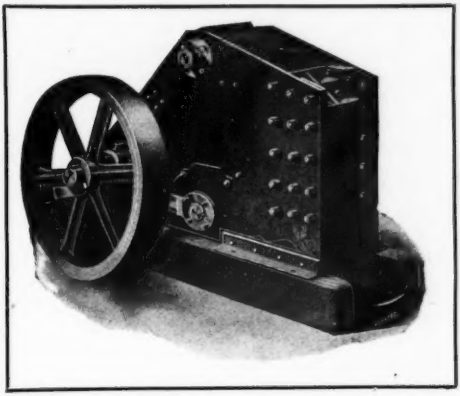

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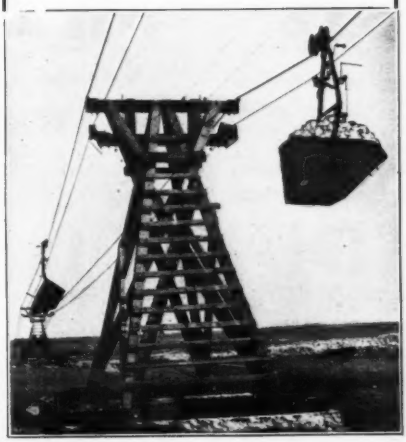

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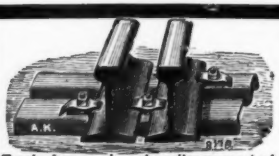

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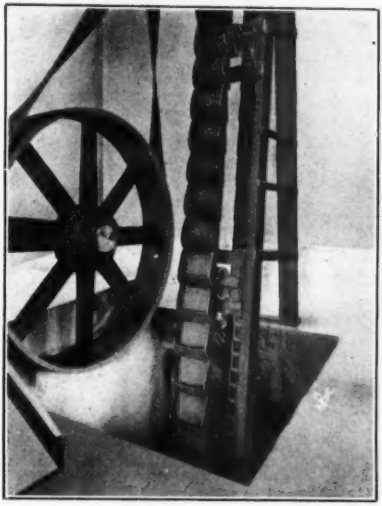

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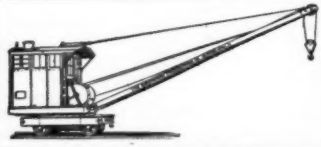

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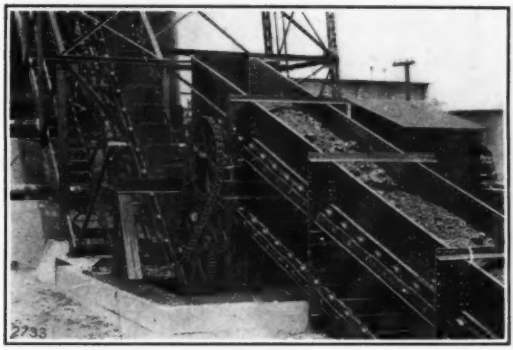

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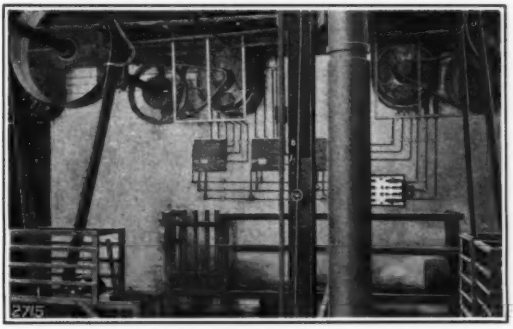

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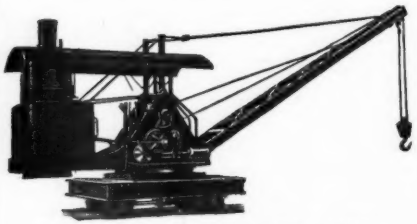

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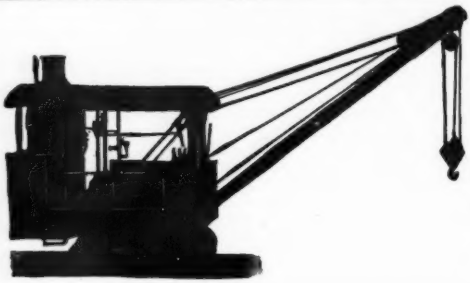

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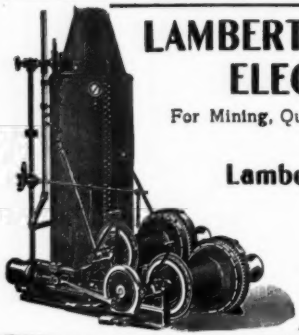

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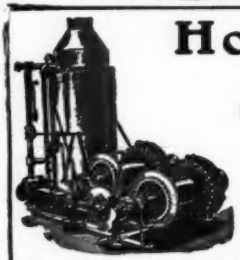

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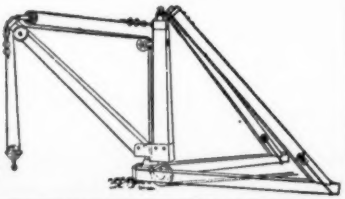

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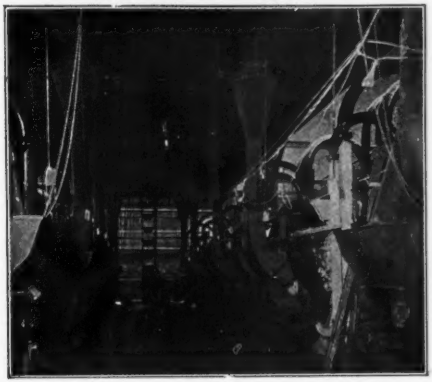

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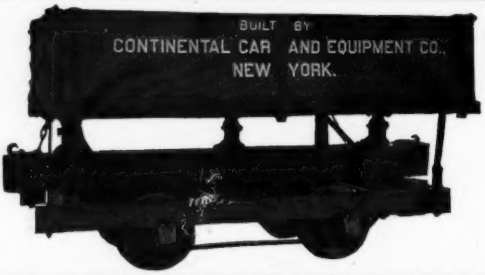

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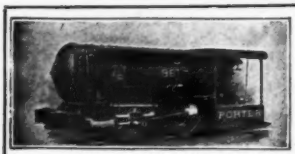

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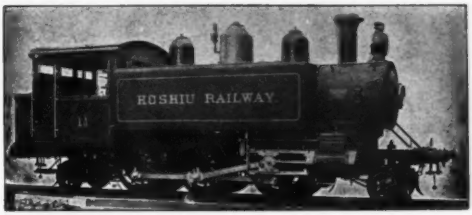

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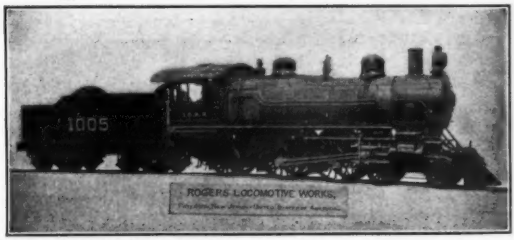

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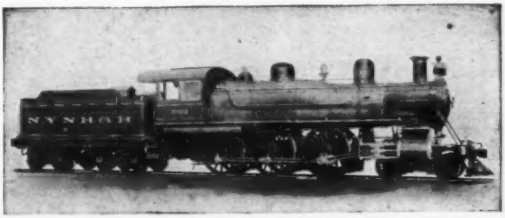

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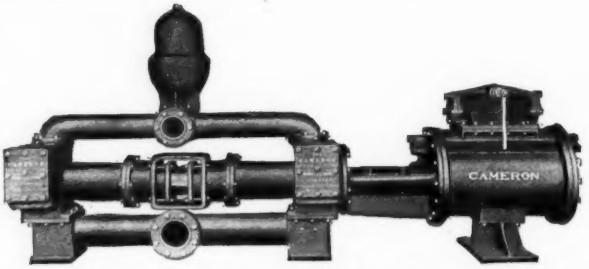

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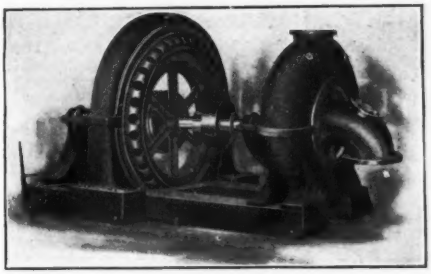

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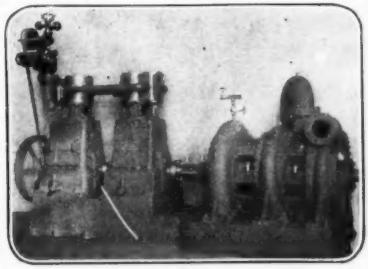

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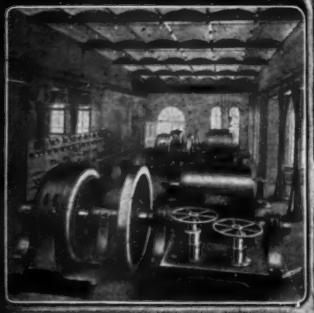

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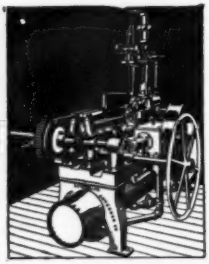

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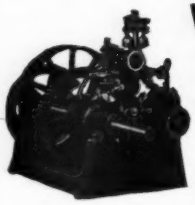

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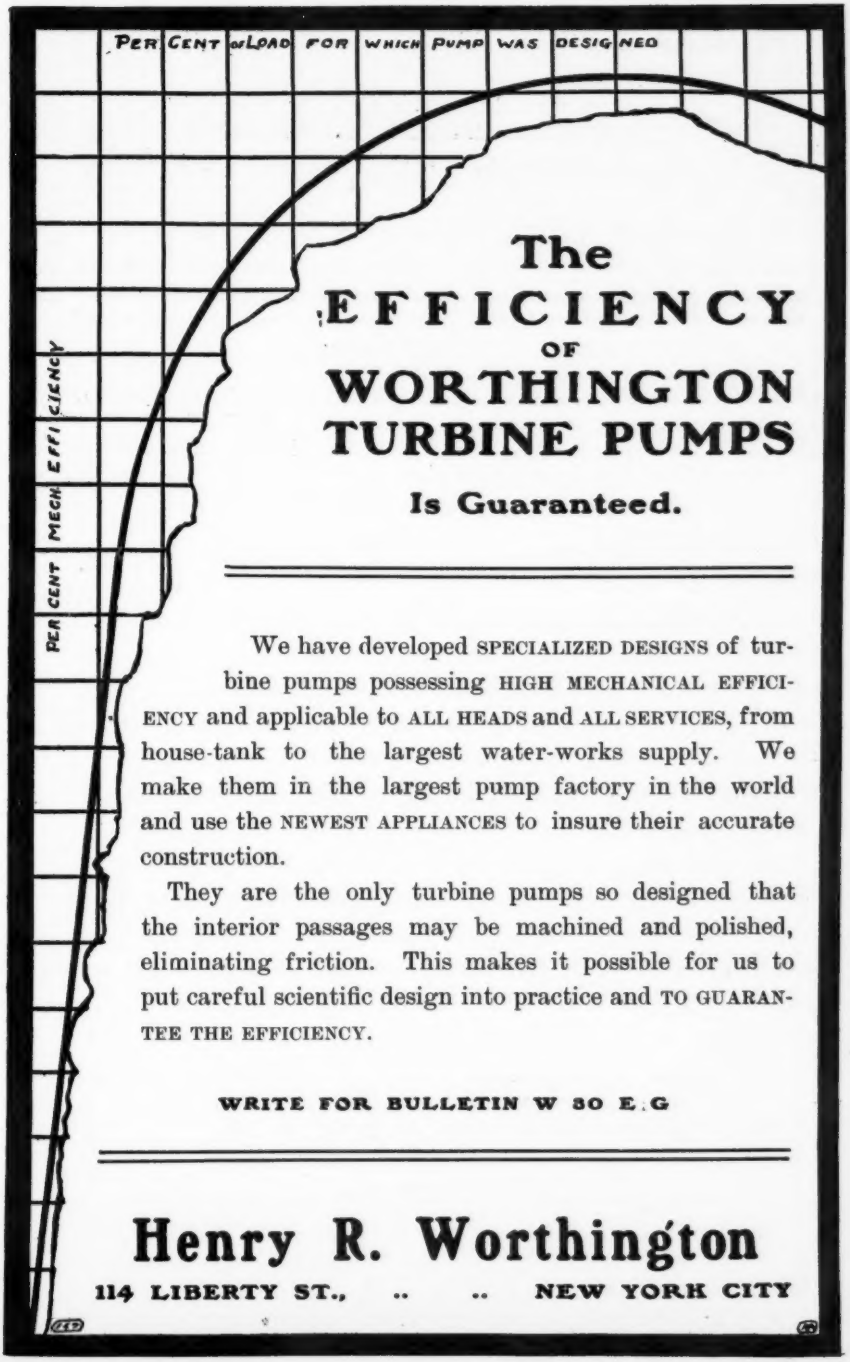

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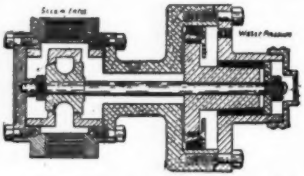

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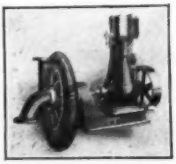

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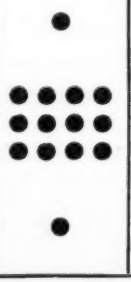

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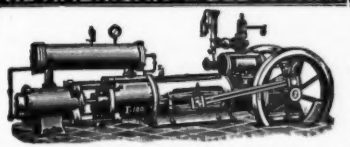

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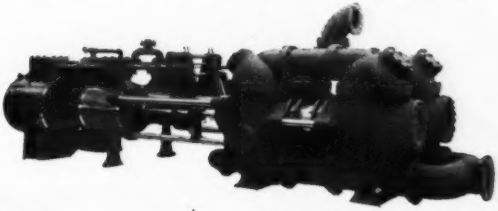

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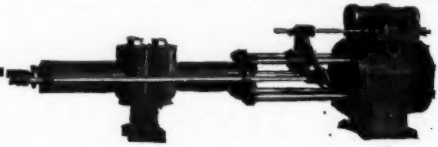

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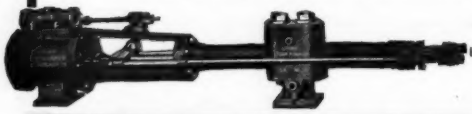

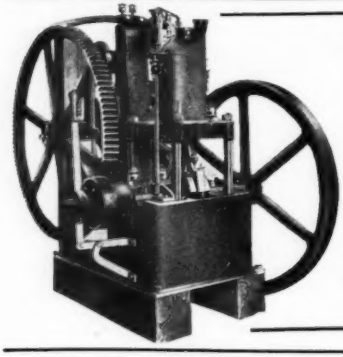

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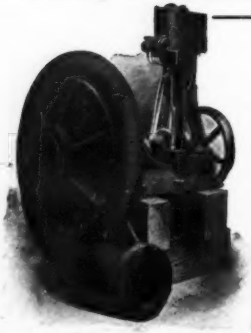

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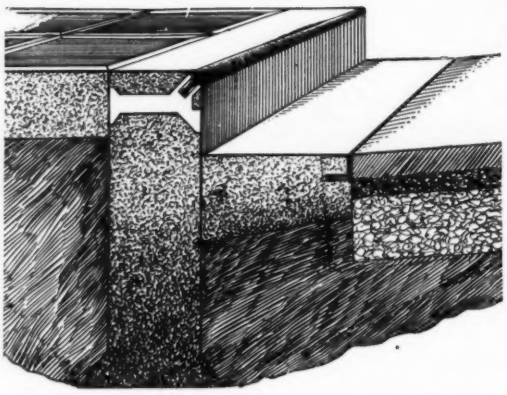

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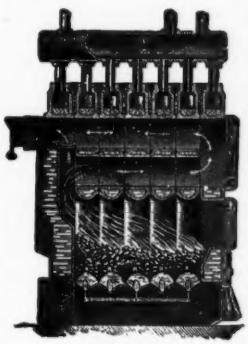

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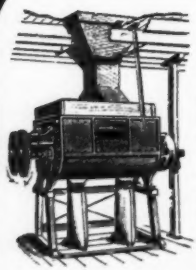

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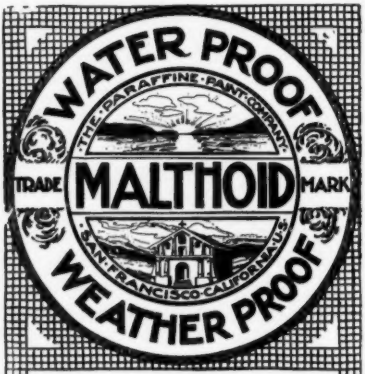

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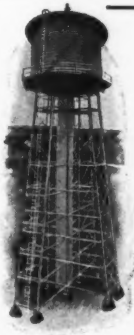

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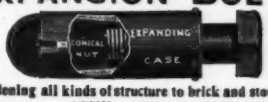

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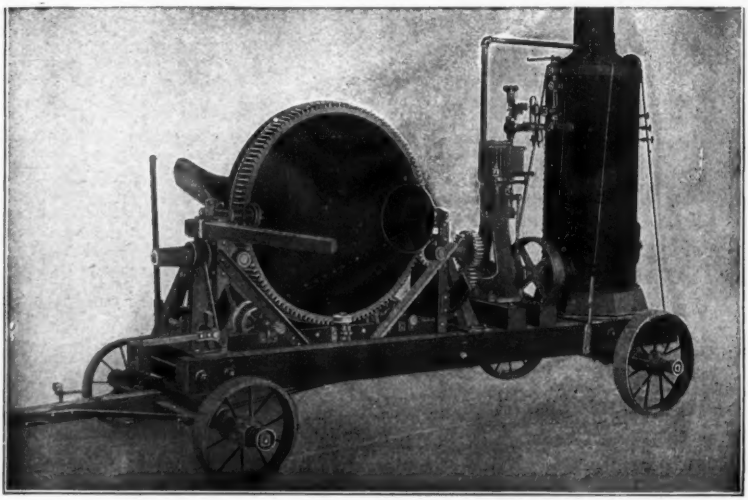

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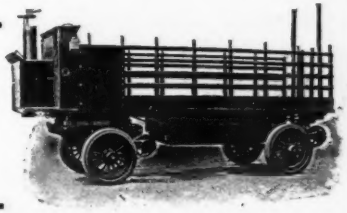

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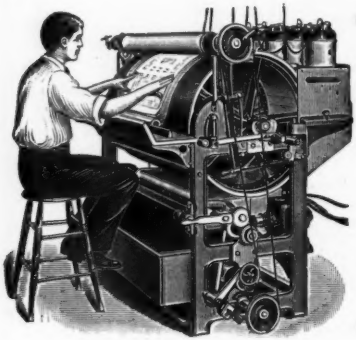

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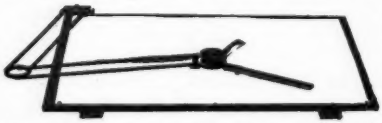

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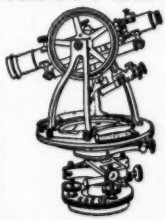

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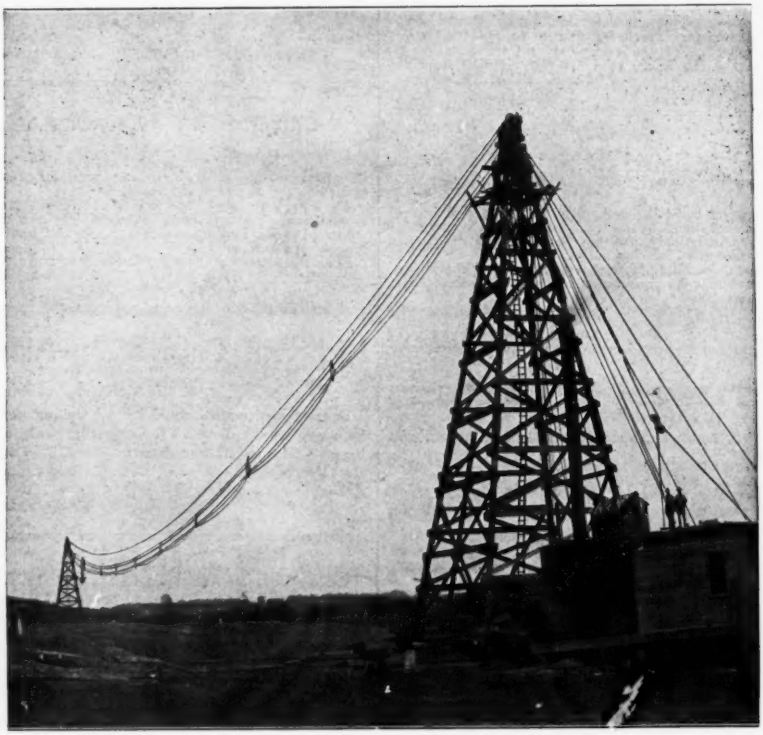

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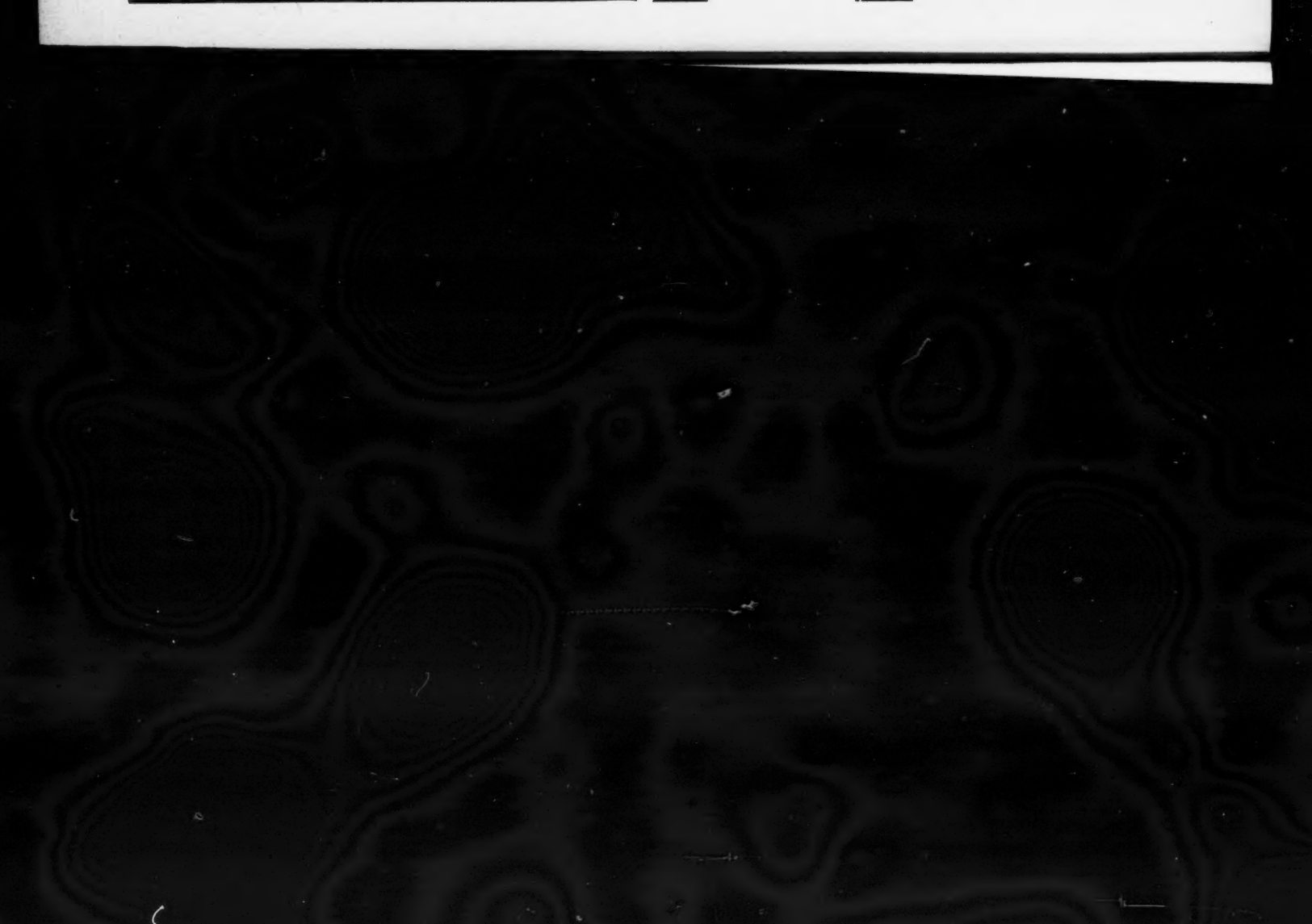

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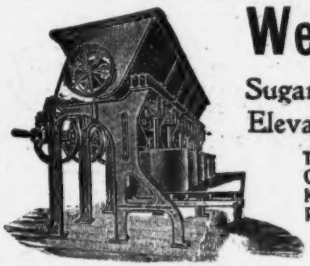

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